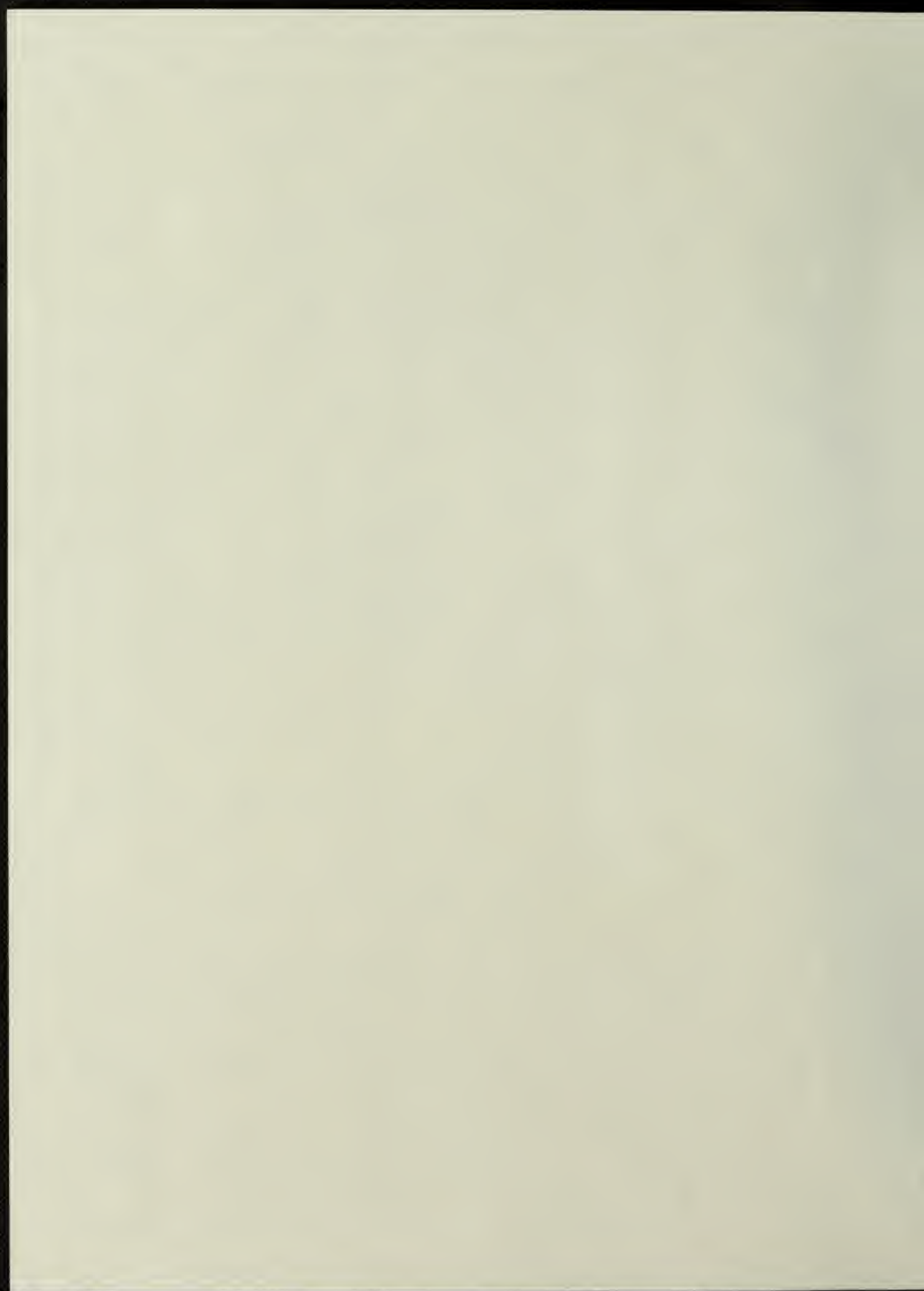


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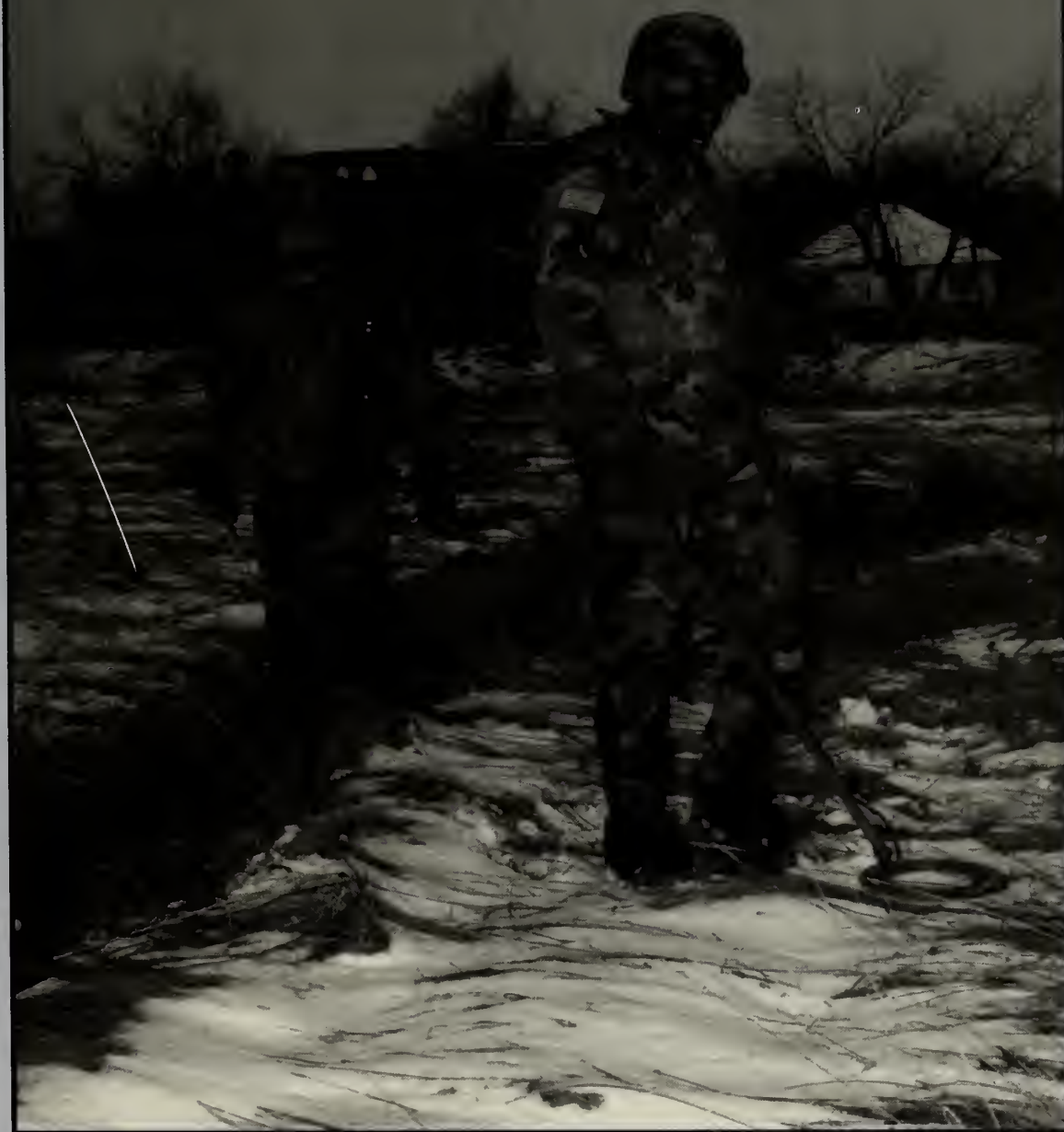
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THE PROFESSIONAL BULLETIN FOR ARMY ENGINEERS

March 1996

Mine Awareness



Headquarters, Department of the Army

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CLEAR THE WAY

By Major General Clair F. Gill
Commandant, U.S. Army Engineer School

The expression *Clear the Way* is a symbol of pride to U.S. Army engineers. The expression ties us to the combat engineer mission of mobility operations during the offense and reflects our military doctrine, that only by offensive operations can we achieve decisive results. The expression has been used before. During our Civil War, the 28th Massachusetts Regiment (part of the famed Irish Brigade and one of several "Irish" regiments that fought on both sides), embroidered their standard with the Gaelic *Fáil an Bealach!* (Clear the Way!) and adopted it as their battle cry.

Today, the expression *Clear the Way* has a new connotation with the American soldiers of the NATO Implementation Force (IFOR) in Bosnia. Clearing the way refers to the dangerous mission of countermine and counter unexploded ordnance (UXO). Engineers have the lead to protect the entire force in an area that has been the contentious prize of three opposing organized forces and numerous other factions with narrow agendas. The result is a very thickly mined area of operations and a mixed bag of mine types and fuze combinations. The situation has focused attention on the countermine challenge to a degree of interest that was simply not possible during peacetime exercises and simulations. This issue of *Engineer* includes articles on countermine techniques and procedures (page 3) and countermine awareness (page 11).

Recently, I was called upon to testify before the House Committee on National Security during joint sessions of the subcommittees on Military Procurement and Military Research and Development. Let me share those key issues with you. In Bosnia, the countermine challenge is part of force protection rather than the normative mobility battlefield operating system. Our doctrine specifies *breaching* operations to clear a safe path through a minefield for the use of troops and vehicles. Our current equipment is optimized for rapid breaching operations.

The Army also conducts *clearing*, which is the removal of mines within the minimum area required for immediate military use. An example would be to clear an area required for a forward supply point or a route, such as Route Arizona in Bosnia. The U.S. Army does not conduct *demining*, which is defined as the complete removal of all land mines and UXO from an area to safeguard civilian populations. Specifically for Bosnia, a provision of the Dayton Accords requires the former combatants to remove mines and minefields.

American forces in Bosnia have a complete toolbox to deal with the mine threat there. But, like the general mechanics' tool kits, there is no single tool or single set of component solutions to all countermine situations. There is no silver bullet.

First, developing soldier awareness is key—it's impossible to overemphasize the importance of a "mine aware" soldier! Soldiers receive mine and UXO identification and hazard training during their initial entry training. This training is reinforced for engineers during their advanced individual training to include additional mine and UXO identification, marking, detection, and removal. As sergeants and lieutenants, our engineer leaders are trained in these same tasks, as well as in the mechanics of training, planning, and leading countermine operations. After schoolhouse training, soldiers conduct unit training on specific unit responses to mines and minefields. Finally, prior to a deployment, we conduct mission training on the particular mine threat and effective countermine responses within that area of operations (AO).

The countermine equipment in Bosnia not only includes the detection, breaching, and protection items authorized on unit tables of organization and equipment but also developmental items rushed to the AO by Army laboratories, academia, and industry. Such equipment as three types of remote-controlled countermine systems, thermal-signature

**“Developing soldier awareness is key—it’s
impossible to overemphasize the importance of a
‘mine aware’ soldier!”**

mine-avoidance suites, minifails, and a foamed plasticizer that disables fuzes are all part of the Bosnia countermine toolbox. Other promising state-of-the-art systems are on the way.

The congressional committee members expressed their grudging satisfaction with the state of countermine and mine-awareness training, but they were much less pleased with the current suite of countermine equipment. One congressman, expressing his dismay at the apparent lack of an effective single system, said, “If we can put a man on the moon, we should be able to field an effective countermine system!” One cannot fault the congressman’s logic—it reflects American faith in technology and our desire for solutions.

In the aftermath of the congressional testimony, several high-level problem-solving organizations have been established to focus countermine solutions in Bosnia and beyond. The senior of these temporary organizations is the Army Countermine Task Force. This task force will be co-chaired by Brigadier General Roy Beauchamp, from the Army Materiel Command (AMC/SARDA), and myself, representing the Training and Doctrine Command (TRADOC). The purpose of this task force is to accelerate the temporary fielding of promising equipment; effective doctrine; and the tactics, techniques, and procedures that will improve our capability to survey, reconnoiter, detect, avoid, clear, neutralize or breach land mines, minefields, or UXO that U.S. forces may encounter in Bosnia. The objectives are to make state-of-the-art equipment available to our soldiers in Bosnia, to move promising technology from the laboratory to the soldier in Bosnia as quickly as possible, to provide safe and effective tools, to unburden operational commanders from testing a host of raw countermine ideas, and to be prepared to transition the countermine experiences in Bosnia to future programs and operations.

Within the TRADOC community (and not necessarily as a direct response to the Bosnia mission), I have asked the TRADOC commander to commission a Countermine Center of Excellence, with the U.S. Army Engineer School as the lead. The general responsibilities are:

- Serve as the TRADOC reviewing and integrating agency for countermine doctrine, training, leader development, organization, materiel, experiments, and demonstrations.
- Serve as the TRADOC representative for joint and combined countermine issues.
- Serve as the single point of contact on countermine initiatives for the Army in the field.

These organizations are not debating associations; they have the power to move large amounts of resources and to compel quick actions. The stakes are too high to do otherwise.

Additionally, the Engineer Center and School is establishing the Demolitions and Explosives Training Center to enhance our schoolhouse and exportable training in demolitions, countermine, booby traps, and UXO. This center will help us quickly transition the latest technology and lessons learned into doctrine.

In conclusion, we must meet the challenge of countering mines in Bosnia and, while we cannot safeguard every footfall, each mine strike drives the message home. Every idea will receive consideration; nothing will be rejected! Congress has pledged the financial resources necessary to bring our countermine capability up to the challenge of Bosnia and beyond. Our countermine capability is in the integrated application of doctrine, training, leader development, organizations, and materiel. I solicit your good countermine ideas—we need them now! Countermine operations will be a big part of our upcoming senior engineer leadership training in April. But get your ideas to me now. *Fáj an Bealac!*

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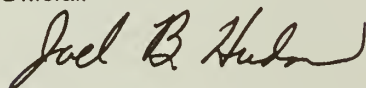
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Cover photos: A U.S. Army combat engineer sweeps for mines in a field in Bosnia. A similar mine-clearing technique was used by soldiers in World War II, as shown on the back cover. Front cover photo by SSG Brian Cumper.

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In response to the mine threat in Bosnia, we have included two articles with information on route-clearance techniques. The first article expands information published in the April 1995 issue of ENGINEER. Intended for the individual combat engineer and his leader, it describes countermine techniques used in earlier conflicts. The second article is based on current doctrinal mine-awareness training provided by the U.S. Army Engineer School.



Photo by Tom Reeder

Techniques and Procedures for Route Clearance

By William C. Schneck, Jr. and Brian M. Green

Land mines are the major threat to U.S. forces participating in Operation Joint Endeavor in Croatia and Bosnia. The belligerents have laid an estimated 4 million to 5 million mines in the former Yugoslavia during the four years of civil war. Frequently they emplaced mines randomly along lines of communication (LOC) through this rugged country.

Overview

This is not the first time that U.S. military engineers have been required to sweep routes for randomly emplaced mines. The United States learned many lessons about route clearance during the Vietnam War and had to relearn them a few years ago in Mogadishu, Somalia. While the U.S. can't eliminate all casualties or equipment damage

from mines, leaders can take steps to reduce these incidents to a minimum. An aggressive mine-awareness training program for all personnel in theater is an effective means of reducing casualties and equipment losses (see article, page 11).

Mines placed along LOC are cleared by a combined arms organization. The sweep team usually consists of engineers, infantry, armor, and/or military police. Tanks and Bradleys should follow well behind the sweep team to cover them with fire and to move forward to destroy an ambush if one is initiated. Flank security of the sweep team should also be considered.

A maneuver company commander or battalion commander normally commands a mine-sweeping operation and is responsible for synchronizing the various elements in the operation. The senior engineer present is responsible for advising the commander on engineer capabilities and weaknesses; he also supervises the subordinate engineer elements.

Threat Considerations

The mine threat is real. To date, U.S. forces in Bosnia have had 10 mine incidents involving seven antitank (AT) mines, four anti-personnel (AP) mines and one piece of unexploded ordnance (UXO). These incidents resulted in one death and seven wounded, as well as one destroyed HMMWV and seven damaged tracked vehicles.

To fully appreciate the mine situation, it is necessary to understand and respect (as in do not underestimate) the fellow who emplaced the mines:

- ❑ He is as smart as you are and more creative.
- ❑ He is part of the Yugoslavian environment and culture.
- ❑ He is motivated to kill (not wound).
- ❑ He is politically aware and will exploit the news media.

Former combatants in the Yugoslavian civil war employed some sophisticated mine-laying techniques that are shown in Tables 1-3. Because of the threat they pose, the individual combat engineer and his leader must maintain constant situational awareness and be flexible enough to adapt their equipment and techniques to the nature of the mine threat at any given time. U.S. combat engineers need to fully understand these mining techniques and should consider adopting some of them. In many cases, the time required to employ them is not excessive.



Photo by 1SG Johnson

This 2 1/2-ton cargo truck from the 568th Engineer Company is protected with 1/4-inch mild steel plates, angle iron, plywood, and sandbags.

Route-Clearance Considerations

When participating in a route-clearance mission, engineer soldiers should consider the following countermine functions. An asterisk (*) in these functions and throughout the rest of this article denotes techniques and information derived from non doctrinal sources.

Detection. Mine detection is the most important countermine function during route clearance. However, effective mine detection takes time. *Do not* sacrifice engineers because of someone else's unreasonable impatience! Do not take any more risks than the situation requires. Nonengineers (outside the chain of command) may become unreasonably impatient at the delay caused by a mine sweep. In that case, the senior engineer should advise them of the situation and let them determine whether or not to bypass the sweep team.

Several techniques may improve mine-detection efficiency:

- ❑ Thoroughly check all suspicious areas, including road craters, bypasses, potholes, culverts, fords, intersections, turn-around areas, abandoned roadblocks, and choke points.
- ❑ Observe people along the route. Increase alertness when a normally crowded area is abandoned. If questioned, local civilians may provide critical information about mined areas. All such information, however, should be carefully verified.
- ❑ Use binoculars to scan the route ahead to identify hazardous areas where increased alertness is needed.*
- ❑ Use abandoned mined areas to practice locating mines visually. In Vietnam, 50 percent of the mines were detected visually and 33 percent were detected with metallic mine detectors (most of them had metal cases). Watch for mine packing materials such as wood boxes, metal cans, and cardboard tubes.*
- ❑ Ensure mine-detector operators and probers are highly trained and experienced. Rotate them every 20-30 minutes. The average soldier can effectively operate a detector for one turn every 4 hours.*

- ❑ Sweep the entire road, including shoulders, to a minimum of 5 meters from the edge of the road. This width allows most vehicles to do a U-turn or to pull off to the side to allow another unit to pass. Watch for trip wires along the shoulders. *Note: Dirt and gravel shoulders, the easiest areas to mine, are the most commonly mined parts of any road in Bosnia.*
- ❑ Consider supplementing the route-sweeping teams with mine-detection or explosive-sniffing dogs with military police handlers. When employed, the handler and the dog must be considered an indivisible element. The dogs can work 3 to 4 hours in moderate climatic conditions, and this period may be extended if the dogs take a 10-minute break every hour. Dogs require special veterinary support to retain their effectiveness. They may not differentiate individual mines in heavily mined areas and may be affected by wind speed and direction. Multiple teams are needed to conduct sustained operations. The dog handlers may provide additional employment recommendations.*
- ❑ Do not assume that a road is cleared when it passes through a friendly village or outpost or if it has not been under continuous friendly observation since it was last swept.*
- ❑ When the probing methods usually employed are not sufficient to uncover mines in roadbeds of compacted rock and clay, use a knife or bayonet to chip and pry them out.*
- ❑ Remove all items on the road that cause a positive reading on a metallic mine detector in the initial phases of a sweep operation. Their removal will save time on subsequent sweeps by significantly decreasing the number of false positive readings on the mine detector.*
- ❑ Increase the size of the basic sweep team to allow one metallic mine detector for every 2 meters of road width (including the shoulders), plus two in reserve. Maintain an offset of about 25 meters between detector operators. If a positive reading is obtained, mark the location and have probes search the area with assistance from the two reserve detectors. This technique allows the primary detector operators to remain together and continue their sweep, thus ensuring complete and continuous coverage of the road.*
- ❑ When command-detonated mines are a threat, look for possible trigger points along the route and remove them if possible.*
- ❑ When command-detonated mines are a threat, position flank security well forward of the sweep element. They carefully search for wires and other signs of command-detonated mines or

ambushes. If the flank element is close to a tree line, a security team should sweep the tree line ahead of the element that is checking for command firing wires. Look for disturbed earth or foliage used to cover firing wires. In Vietnam, engineers located these wires by having a soldier with each flank element drag a pick or bush hook along the ground while he moved in a zig-zag pattern between the flank element and the road.* Considering the large number of mines in Bosnia, this technique should be used only if the threat of command-detonated mines becomes significant.

- ❑ Use a leaf blower to remove light, dry snow before sweeping the ground with a metallic mine detector when conditions warrant. In this incremental process, a small patch of ground is cleared of snow before it is swept for mines, then the process is repeated. *Note: The sensitivity of pressure-fuzed AT and AP mines may be greatly reduced in snow and frozen ground. Therefore, ground that was crossed safely during the winter may become dangerous after the spring thaw begins.**

Additional threat mine-laying techniques and detection considerations are shown in Table 1, page 6.

Reporting. Timely, accurate reporting is critical to saving lives. Accurate reporting allows the battle staff to analyze and distribute information on the overall mine situation and to develop appropriate countermeasures. Consider the following guides:

- ❑ Provide a situation report at designated checkpoints and after completing a mine sweep.
- ❑ Send a spot report in a SALUTE format to the battalion tactical operations center immediately after a mine is discovered or detonates. The SALUTE report must contain an accurate location (coordinates) of the incident. Forward a written report (see figure, page 7) containing all facts and the commander's comments within 24 hours of the incident. If possible, include sketches of the site showing where the mine was, road shoulders, center of road, crater dimensions, etc. Send recovered information and materials to the S2 within 24 hours.

Neutralization. While many potential mine-neutralization hazards are obvious, some are not. Neutralization teams must proceed with caution and patience. The following techniques may be employed:

- ❑ Only one member of the sweep team will neutralize mines. All others will move a safe distance away.

Table 1. Mine-Detection Techniques

Threat	Effects	Countermeasures
Low-metal mines.	Very difficult to detect using the AN/PSS-12 metal mine detector. 1	1) Drastically reduce the sweep rate. 2) Lead with probes or mine-roller-equipped tanks and follow with AN/PSS-12 detectors. 3) Look for visual indicators. 4) Supplement sweep teams with infrared (IR) sensors.
Antitank (AT) mines stacked with dirt between them.	Conceal presence of lower mines.	Resweep the hole after lifting or neutralizing a mine.*
Stacked low-metal AT mines with only the bottom one fuze.	The only metal in some mines is in the fuze. The depth of the buried fuze makes detection impossible.	1) Look for visual indicators. 2) Supplement sweep teams with IR sensors.*
Metal debris (such as machine-gun links) scattered across road surface.	Slows the sweep rate and makes operators complacent.	Ensure operators are highly trained, experienced, and can differentiate metallic debris from a mine.
Metal AT mine (either surface laid or buried) surrounded with a buried low-metal AP mine cluster or buried low-metal AT mines.	The metallic mine masks the presence of low-metal mines close to it.	1) Probe the area around the mine before kneeling down to investigate a possible detection.* 2) Proof the entire width of a route as a routine part of mine sweeping.*
Low-metal AT mine placed over a metal culvert.	The culvert masks the presence of low-metal mines.	1) Look for visual indicators. 2) Supplement sweep teams with IR sensors.*
AT mines placed at ford sites adjacent to destroyed bridges.	Thoroughness of the sweep decreases due to the discomfort of sweeping a cold, wet ford site.	1) Maintain a disciplined sweep technique in the cold water. 2) Use divers if available.
Minelfields emplaced with a mix of inert mines.	Sweepers become complacent after locating several inert mines.	1) Treat each mine as live; the one treated as inert may be a live one with an anti-handling device (AHD). 2) To a trained ear, the Yugoslavian-made V-series training mines have a stronger signature on a mine detector than a live mine.
Roadblocks consisting of a series of earth berms with AT mines placed only in the last one.	Sweepers become complacent after clearing several berms and finding no mines.	Maintain a disciplined sweep technique.

1 The AN/PSS-12 can detect low-metal mines such as the PMA-3 and TMA-4 to a depth of about 2 inches in a laboratory environment using a slow sweep rate. One Canadian veteran of U.N. operations in Bosnia stated that they led with probes or a mine roller 80 percent of the time.

* Denotes non doctrinal information.

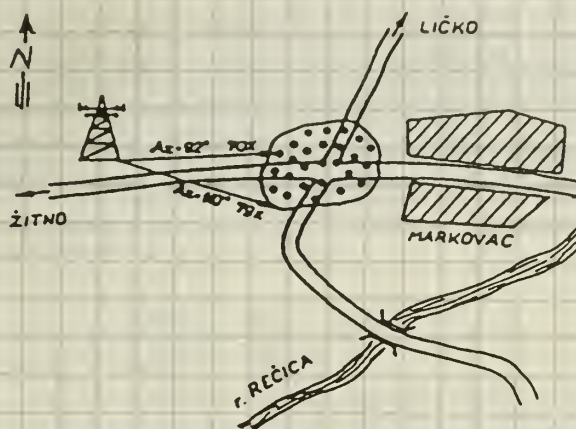
- ❑ The common practice is to *blow in place* any enemy mine detected. This action often creates a large crater in the road that must be backfilled and capped. For example, craters made by TMA-3 mines are usually 12-18 inches deep and 30-36 inches across. Since cratering is inevitable, road-repair equipment and fill material must accompany the sweep team.
- ❑ In many situations, it may be preferable to extract mines located on a LOC. Removing mines allows the road to be reopened immediately, eliminates the need to repair craters, and denies the enemy an excellent location for laying their next mine (in a road crater filled with loose gravel). Additionally, mines removed using this

technique pose little danger to personnel. To extract a mine, first check for stacked mines, antihandling devices (AHD), and booby traps by thoroughly searching the mine by hand. Then extract the mine using about 150 feet of parachute cord, an A-frame, and a grapnel. Pull the mine at least 1.5 meters from the hole and wait at least 5 minutes before approaching it. (See STP 5-12B1-SM, *Combat Engineer Soldier's Manual, Skill Level 1*, dated December 1990, page 2-200, for full details.) If multiple mines are extracted from an area, pick up the fuze AT mines by hand and move them to a single point for demolition to save both time and explosives. Remember that these mines are still fuze.*

MINE INCIDENT REPORTING CHECKLIST*

(*Possible format for inclusion in Unit's SOP)

Unit _____ Date _____
 Name _____ Time _____
 Exact location (include map grid/map number) _____
 Site description (for example, creek, jungle, path) _____
 Activity (for example, patrol) _____
 How was mine discovered _____
 What detection equipment was used, if any _____
 Mine size _____ Mine switch _____
 Mine color _____ Mine markings _____
 Mine casing _____ Mine contents _____
 Crater size _____
 Color and condition of crater _____
 How camouflaged _____
 Actions taken to neutralize/remove mine _____



Front

Back

Sample Mine Incident Report

This technique is not normally recommended for use against AP mines because of their sensitive fuzing. However, if necessary, rig the pull line so that the mine can be dragged out of the way and into a suitable area before destroying it with explosives.

Note: Do not use this technique against tilt-rod or magnetic-fuzed mines.*

- ☐ When the situation permits, much time can be saved if the finding unit (usually the lead element) marks the mines and bypasses them, leaving demolition to the follow-on supporting element. This technique reduces the sweep time. If multiple mines are to be blown in place, use a ring main or line main to reduce the demolition time.*
- ☐ When mines are blown in place, stand off about 413 meters (preferably in an armored vehicle) in case stacked or boosted mines are present.*
- ☐ Check both ends of all trip wires (both slack and taut) for "breakwire"-type fuzes before cutting them. Breakwire-fuzed mines should only be blown in place or neutralized with a grapnel.*
- ☐ After neutralizing a mine, check the hole again with a metallic mine detector and a probe in case the enemy placed more mines in the hole.*
- ☐ When firing wires or mines are detected, one soldier will immediately search for lead wires

because all ordnance, including pressure-fuzed AT mines, can be rigged for command detonation. If lead wires are found, he should cut one at a time and shunt them, then continue searching for the mine.

Alternatively, one soldier may attach additional firing wire to the wires leading into the road and then move to a safe position and try to fire the mine electrically. If the mine does not detonate or if demolition in place is unacceptable, he sweeps along the wire toward the road until the mine is found; then he removes it from the LOC using an A-frame and a grapnel. Remember that AP mines may be placed along the firing wire to protect it. If the mine is not found, he sets a row of charges on the road and blows them all.*

- ☐ When an unidentified explosive device is discovered, the commander (with his senior engineer or EOD support present) must decide if a recovery attempt is warranted. This decision must be based on the essential elements of information specified in the operations order and guidance from higher headquarters. Photograph the device before demolition if possible. If the decision is to recover an unidentified explosive device, only one soldier attempts the recovery. He digs carefully around the explosive device

Table 2. Mine-Neutralization Techniques

Threat	Effects	Countermeasures
Coupled mines (such as the Romanian MC-71 or improvised mines) where the fuze is separated from the mine body.	May be used to destroy mine plows and roller-equipped tanks.	Dismounted mine sweepers or standoff mine-detection vehicles should always precede mounted elements of a sweep force.*
Side-attack mines (such as the Yugoslavian Cobra or improvised mines).	May be used to destroy mine plows and roller-equipped tanks.	1) Flank security elements should precede mounted elements to detect and neutralize this threat.* 2) Neutralize visually detected side-attack mines using disruption by gunfire.* 3) Check carefully for AP mines when approaching this type of mine.*
AT mines fitted with AHD.	1) Discourages manual lift techniques. 2) Destroys mine plows.	1) Blow in place or use an A-frame or tripod to lift mines from a remote location. 2) Precede mounted elements with dismounted sweepers or standoff mine-detection vehicles.* 3) A strong signal on the AN/PSS-12 for a normally low-metal mine may indicate the presence of an AHD.*
Breakwire-fuzed fragmenting AP mines.	Cutting what appears to be a slack trip wire activates the mine.	Check both ends of all trip wires (both slack and taut) for unusual fuzing before cutting them.*
Low-metal AP mines laid along trip wires. (This technique is used frequently in Bosnia.)	Personnel tracing trip wires become casualties.	1) Pull the trip wire using a grapnel from a covered position a safe distance away. (Remember that the lethal range of some mines in Bosnia is 50 meters.) Then carefully sweep/probe the area that was under the trip wire. 2) Probe along trip wires; do not become overly focused on the wire.*
Multi-impulse AT mine is improvised by placing a simple pressure-fuzed AT mine upside down in a conical hole.	Mine detonates after repeated vehicle contacts force it to the bottom of the hole. Mine rollers do not reliably clear this arrangement.	1) Employ good detection techniques. 2) A circular depression is a visual indicator that this technique was employed.
Surface-laid AT mines fitted with AHDs appear to be hastily laid.	Soldiers grab the mines to throw them off the road.	1) Assume <i>all</i> mines are fitted with AHDs. 2) Use A-frame or grapnel to move mines.
Surface-laid AT mines surrounded by trip-wire fuzed Bouncing Bettys.	Soldiers activate the trip wires when they walk up to grab the AT mines and throw them off the road.	Maintain sweep discipline when approaching surface-laid mines.

* Denotes nondoctrinal information.

until a grappling hook or wire can be passed through or under it. Then he attempts to pull it with a line and a small A-frame. If the recovery attempt becomes too dangerous, he blows the device in place. Under no circumstances should anyone attempt to disarm an explosive device if the NCO in charge does not consider it safe. Do not take unnecessary risks.*

Additional neutralization techniques are described in Table 2.

Proofing. Countermine operations are rarely 100 percent effective, and mines sometimes slip through. Proofing confirms the quality of a sweep. Consider using the following proofing techniques:

- Follow each mine-sweep team with enough proofing devices to cover the entire width of the route, including the shoulders. Proofing devices include mine-roller-equipped tanks, improvised mine rollers, other tracked vehicles (the heavier the better), and loaded 5-ton dump trucks driven in reverse. (Driving in reverse reduces the possibility of serious injury to the driver if the truck detonates a mine.) The proofing vehicles maintain a minimum distance of 25 meters from all personnel in case an undetected mine detonates. Dump trucks loaded with gravel follow the mine-sweep teams and proofing devices to fill craters or potholes in the road.*
- To defeat magnetic-influence fuzed mines, fit a magnetic mine countermeasure system such as the Improved Dog-bone Assembly to the mine-

Table 3. Survivability Techniques

Threat	Effects	Countermeasures
Boosted mines (stacked with additional mines or explosives beneath them).	Increase damage to vehicles.	Lead with mine-resistant vehicles or vehicles fitted with mine-protection kits.*
AT mines laid in the road with AP mines laid on the shoulders.	Survivors of a mine-immobilized vehicle dismount into an adjacent AP minefield.	Dismount onto the road. Do not move onto the shoulders without first looking for AP mines.*
Claymore-type mines placed in trees.	Shoot down into the kill zone through the top of the vehicle.	Reinforce the top when improvising vehicle protection.*

* Denotes nondoctrinal information.

roller-equipped tank or fit the Field Expedient Coil System to the lead armored vehicles. To date, there are no reports of magnetic-influence fuzed mines in Bosnia.

- ❑ Mine rollers are extremely heavy (10 tons) and may damage unimproved roads. The heavy mine-roller-equipped tank (MLC 67) exceeds the capacity of many bridges and may be unable to negotiate choke points. Together, the task force engineer and the battalion S2 must identify bridging constraints during the planning process of a route sweep. If roller-equipped tanks are unsuitable or unavailable, improvised, light-weight expendable rollers may be used.*

Protection. As noted above, countermining measures are rarely 100 percent effective. The following procedures will reduce casualties if a mine detonates:

Mounted Operations

- ❑ Wear protective vests, helmets, and seat belts.
- ❑ Keep vehicle speeds at less than 25 mph. The emotional surprise (of the driver) and physical damage (to the vehicle) caused by a mine detonation will cause a vehicular accident.*
- ❑ Store all loose articles because they may become high-speed projectiles if a mine detonates. Leave any unnecessary equipment at the base camp.*
- ❑ Fill each tire with water about two-thirds of the way to the rim to help deflect a mine detonation. Add antifreeze to the water in cold weather.*
- ❑ Place two layers of sandbags on the floor of the vehicle cab and on the cargo bed to help protect personnel from the effects of a mine blast. Cover the sandbags with heavy conveyor belts or rubber matting to reduce secondary fragments. Do not put rocks in the sandbags because they could become secondary missiles if a mine detonates. Place sandbags on nonballistic windshields and

on the hood above the dash to protect against flying glass and metal.

- ❑ Strive for a uniform appearance of all vehicles. Cross load key personnel and equipment.
- ❑ Follow the tracks of the vehicle ahead, but avoid old vehicle tracks because they may be mined.*
- ❑ Keep the hatches on armored vehicles open to vent the pressure pulse from a mine detonation.*

Dismounted Operations

- ❑ Maintain proper interval.
- ❑ Wear appropriate protective equipment (standard protective vest and helmet). When conducting countermining operations, also wear the Body Armor Set, Individual Countermine (BASIC). It includes a ballistic face shield and goggles, anti-fragment trousers, and blast overboots.
- ❑ Watch for visual mine indicators.
- ❑ Do not wear sunglasses because they significantly decrease the ability to spot trip wires.*

Mounted and Dismounted Operations

- ❑ Rehearse unit-developed battle drills. At a minimum, units should develop and rehearse drills to clear mines after they are detected, to evacuate casualties from a mined area, and to react to a mine detonation during convoy operations.
- ❑ After a mine incident, immediately establish all-around security and clear the area to the casualty with a sweep team. Do not cluster around casualties. A sweep team will approach casualties first, followed by an aid and litter team.
Note: Because dirt is driven into wounds and traumatic amputation is probable, medical personnel supporting countermining operations must receive additional training on the treatment of mine casualties.
- ❑ Many units establish a procedure for mine sweeps and then never deviate from it. This practice assures the commander a thorough,

well-controlled sweep, but it gives the enemy the advantage to predict movements. He is then able to place his mines to inflict maximum damage.

- ❑ A careless attitude breeds poor security. The enemy may observe this attitude and strike when a unit's guard is down. Physically check likely ambush places. Assume good, dispersed firing positions during halts.
- ❑ Construct mine booms upstream of bridging and fording sites to counter drifting river mines.

Additional survivability techniques are shown in Table 3, page 9.

Closing

Standing in the middle of a road with an AN/PSS-12 mine detector is probably the most vulnerable position to place a soldier. Proper equipment, training, and smart leadership will reduce that risk. Remember, route clearance is a combined-arms operation that requires careful planning, coordination, and execution. Although equipment solutions have not evolved from the painful lessons of Vietnam and Somalia, solid training, patience, flexibility, practice, perseverance, and planning will reduce the loss of life and equipment caused by mined routes.



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MINE AWARENESS

By Master Sergeant Steven Eberharter

With an ever-changing global environment, the probability of deploying U.S. troops to perform various stability and support missions (formerly known as operations other than war) is very real. The unit's need to be situationally aware is extremely critical because each flash point contains its own type of threat to the deployed unit. Like the mine threat that U.S. troops currently face in the former Yugoslavia, many of these threats can be neutralized or reduced through quality training. Quality mine-awareness training not only enhances the ability of the unit to perform its mission but also increases the soldier's confidence that the mission will be accomplished successfully. Mine awareness consists of both individual skills and collective tasks. They are critical, perishable skills that must be trained effectively and sustained routinely. Many engineers learn about the tasks required to perform their wartime missions while attending basic institutional training courses. The problem emerging currently is that knowledge of the

individual mine survivability skills required for stability and support operations is limited.

We must go "back to the basics" to understand the current mine threat. There are more than 100 million mines deployed throughout the world, and about 5 million of them are in the former Yugoslavian region. More than three-fourths of those mines are not marked or recorded. Along with the mines is the additional threat of unexploded ordnance (UXO), which is just as threatening as land mines and can be reduced with the same basic skills. Soldiers must understand how mines and UXO are employed, how to recognize minefield indicators, how to perform self-extractions from a minefield, and how to apply basic survival rules.

Mine Employment

Mines and booby traps are not only employed conventionally by military forces organic to the host country or its

Photo by CPT Shawn Howley



A soldier probes for a mine after visually identifying the indicators.



A soldier searches for mines using an AN/PSS-12 detector during a route-clearing exercise.

enemies but also by terrorists against allied forces or the host country populace. In the latter cases, the threat increases because of the improvised methods terrorists use to emplace mines and booby traps. In conventional mine emplacement, a pattern emerges from the emplacing force's doctrinal guidance, and military forces can use that doctrine to reduce the threat. There is no pattern when improvised mining methods are used, which makes identification, removal, or breaching very difficult. Most of the improvised mining techniques discussed below apply to unexploded ordnance also.

Coupling Mines. Mines are linked together, usually with demolition cord. Once the initial mine is detonated, it will detonate the linked mines.

Boosting Mines. Buried mines are stacked one upon another with the farthest from the surface being fuzed. This reduces the probability of detection and increases the force of the blast.

Sensitizing Antitank Mines. With nonmetallic mines, the pressure plate can be cracked, the spring removed, or the mine explosive cut into smaller mines and employed as powerful antipersonnel mines. If the pressure plate is removed from metallic mines, they can be employed in the same manner.

Mixing Training and Live Mines. Forces employ training mines in the minefield initially and live mines toward the end. The reducing element is led to believe that the minefield is phony and becomes complacent in its reduction activities. Usually the live mines are painted to resemble training mines.

Daisy Chaining Mines. Command-detonated and antipersonnel mines are the most commonly used mines in daisy chaining. The employing force links them with trip wires or detonation cord. As in coupling, once the initial mine is functioned the others will function as well.

Minefield Detection

With all mines, survivability depends on the soldier's ability to detect the threat before contact. FM 20-32, *Mine/Countermine Operations*, describes four methods of detecting mines and unexploded ordnance:

- Visual.
- Physical (probing).
- Electronic (mine detector).
- Mechanical (mine roller).

Minefield Indicators

- ☐ Loose dirt in roadway
- ☐ Damaged vegetation
- ☐ Exposed mines
- ☐ Improvised marking
- ☐ Road repairs
- ☐ Local population avoidance
- ☐ Out-of-place material
- ☐ Damaged vehicles
- ☐ Dead animals
- ☐ Unusual smell
- ☐ Desirable war trophies
- ☐ Trampled or vehicle-tracked area

Figure 1

Equipment availability for physical, electronic, or mechanical detection is limited, so the visual method is best for the individual soldier. The ability to understand and recognize minefield indicators can prevent the individual soldier from becoming a casualty from an unmarked mine or UXO threat. FM 5-7-30, *Brigade Engineer and Engineer Company Operations (Airborne, Air Assault, Light)*, identifies the minefield indicators shown in Figure 1.

Minefield Extraction

A well-developed and well-rehearsed evacuation drill is necessary to extract an individual or a unit from an unmarked minefield. A key individual skill in any evacuation drill is the ability to properly probe for mines. The probing techniques in Figure 2 are described in FM 20-32.

Units must develop evacuation drills for both dismounted and mounted operations. Each type of operation should include a drill using a mine detector and one without. Examples of both methods are shown in Figures 3 and 4, page 14.

Mine-Probing Techniques

- ☐ Roll up your sleeves and remove gloves and jewelry to increase your sensitivity. Wear a flak vest and a Kevlar helmet with the chin strap buckled.
- ☐ Visually inspect the area to be probed.
- ☐ Move into a prone position to reduce the effects of an accidental blast.
- ☐ Use sight and touch to detect trip wires, fuzes, and pressure prongs.
- ☐ Use a slender, nonmetallic object as a probe.
- ☐ Methodically probe every 5 centimeters (2 inches) across a 1-meter (39-inch) front.
- ☐ Probe the ground at a 45-degree angle by gently pushing the probe into the ground.
- ☐ Apply just enough pressure on the probe to sink it slowly into the ground.
- ☐ If an object is detected, carefully remove the surrounding soil (using a "two-finger-sweep" technique) to identify it.
- ☐ If an object is identified as a threat, mark it according to your local SOP and avoid it.
- ☐ Move forward into the cleared area and repeat the procedure. Stay in a prone position at all times.
- ☐ If two or more probers are required, they must be at least 25 meters (85 feet) apart. This creates an area between them that is safe from detonation by other probers.
- ☐ Probing is extremely stressful and tedious. The senior leader must set a limit to the time a prober is actually probing in a minefield. To determine a reasonable time, the leader must not only consider the METT-T factors but also the weather conditions, the threat level, the unit's stress level, and the prober's sensory perceptions, fatigue level, and state of mind. As a rule, one hour is the maximum time an individual can probe, and that is under ideal conditions. Most of our allies and civilian agencies use 20- to 30-minute limits, which is reasonable under most field conditions.

Figure 2

Dismounted Extraction Procedures Without Mine Detectors

- ☐ Freeze and crouch into a low silhouetted position. Be cautious when making this movement to ensure that soldiers do not detonate another mine. If the protective mask is worn on the hip, do not allow it to come in contact with the ground because contact may detonate a mine. Overcome the urge to help casualties; this will prevent you from becoming a casualty too.
- ☐ Designate a security element and a soldier to assist in casualty evacuation.
- ☐ Extract soldiers along the path they entered, stepping in the same places as before if possible; if not, they probe their way out.
- ☐ Set up the security element into a security position. This element should be individuals who are not in the minefield.
- ☐ Extract the casualties as follows:
 - Probe a 1-meter-wide path to the casualty, marking the cleared path as it is probed.
 - Probe around the casualty to clear the area where first aid will be performed.
 - Perform proper first aid.
 - Carry the casualty out of the minefield along the cleared path. (Do not let stretcher parties in unless a 2-meter-wide path has been cleared to the casualty).
- ☐ Clear the minefield, mark the threat, and reassemble the unit at a rally point.
- ☐ Report the incident after all personnel are at least 50 to 100 meters away from the minefield. Do not use the radio in the minefield, because the signal could detonate a mine. If radio transmission is required when soldiers are in the minefield, move the transmitter at least 300 meters from the minefield before transmitting. This will prevent accidental mine detonation from the radio signal.
- ☐ MEDEVAC the casualties.
- ☐ Continue the mission.

Figure 3

Mounted Extraction Procedures With Mine Detectors

- ☐ Halt the convoy and report to higher headquarters.
- ☐ Leave vehicles in position and troops mounted unless directed otherwise.
- ☐ Provide 360-degree security from vehicles.
- ☐ Maintain the position of troops thrown from vehicles if possible. Extract them, using the dismounted evacuation procedures with electronic detectors.
- ☐ If engineers are not available, the senior leader will assess the situation and direct vehicles to back along their entry route tracks. If vehicles are damaged, soldiers will evacuate through the rear of the vehicle along the vehicle entry tracks.
- ☐ If engineers are available, they should sweep the area and provide a cleared lane for movement. The cleared area will be 4.5 meters wide for one lane or 19 meters wide for two lanes.
- ☐ MEDEVAC the casualties.
- ☐ Road guards will guide vehicles through the safe area to ensure that no additional mines are encountered.
- ☐ Mark, record, and report the threat if it has not been done already.
- ☐ Continue the mission.

Figure 4

Survival Rules

In any convoy movement, some rules of thumb should be considered if at all possible. The lead vehicle should be one of the heaviest vehicles in the unit (for example, a 2 1/2-ton or a 5-ton vehicle) and hardened against a mine threat. Heavier vehicles provide better protection against mine and UXO threats. If possible, do not lead a convoy with a HMMWV or a HEMMT, because these vehicles are extremely vulnerable to mine and UXO threats and are difficult to harden without commercial products.

Many of our allies have extensive experience in mine operations. Canada has produced several mine-awareness manuals and videos and has developed "Survival Rules" that U.S. soldiers will find useful (see Figure 5).

Survival Rules

- ☐ If you didn't drop it, don't pick it up.
- ☐ All terrain and structures are potentially mined or booby-trapped.
- ☐ Beware of areas associated with basic human needs. They could be mined or booby-trapped.
- ☐ Report all confirmed or suspected mines immediately.
- ☐ Leave mine disposal to explosive ordnance disposal personnel and combat engineers.
- ☐ Avoid touching or removing foreign objects, no matter how attractive they are. They could be mined or booby-trapped.
- ☐ Stay on the traveled road and avoid verges. They could be mined.
- ☐ Mark and avoid UXOs if possible. Consider them unstable.
- ☐ Develop and rehearse effective evacuation drills.

Figure 5

Mine awareness is a critical, perishable skill. It must be trained effectively and sustained on a continuing basis. If a unit properly trains its soldiers on mine awareness, it will maintain its force, boost the soldiers' confidence in their abilities, and accomplish the unit's mission more effectively. Mine awareness training is not a liability—it's an investment in the unit's future.



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This article is based on information developed by the U.S. Army Engineer Center and the U.S. Army Explosive Ordnance Disposal Center for the Mine Awareness Mobile Training Team. For more information on mine awareness, contact MSG Eberharter at DSN 676-5951; commercial (573) 596-0131, extension 3-5951; or e-mail EBERHARS@WOODVINES.-ARMY.MIL.

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Army Engineers: It's Time to Speak With One Voice

In recent years, joint commands have deployed all over the world to conduct both combat and stability and support operations (formerly called operations other than war). In each instance, engineers played a major role and were essential to the success of the effort. Commanders, however, continually struggled to come to grips with how to best organize, command, and control the engineer forces. Each solution was a little different and while this afforded the joint task force commander maximum flexibility, it repeatedly violated the precept of "train as you expect to fight."

Now, as joint doctrine becomes more directive in nature, it is time for Army engineers to resolve the following issues in the joint arena:

- Who are the key players in writing and reviewing joint doctrine, and who has the lead?
- Where does the engineer element belong on the joint staff?
- How do we advise the joint commander regarding the task organization of his engineer elements to optimize support throughout the operational area?

Joint Doctrine

If we get the doctrine piece right, we have a greater chance for success in the other areas. As it stands now, it is unclear who is speaking

for the Army in the joint doctrine arena.

At a recent joint working group meeting to develop contingency engineer doctrine, numerous Army organizations participated, each with its own agenda. Engineer brigades and groups sent representatives who focused on joint task force operations. The engineer commands sent representatives with an echelons above corps orientation. U.S. Army Corps of Engineers personnel were primarily interested in real estate acquisition and LOGCAP disconnects. The Engineer School's representatives tried to span the entire spectrum but tended to focus on the regimental side of the Corps. If this sounds confusing, you're absolutely right. It is, and the other services are not waiting for us to get our act together.

TRADOC has Army proponentcy to review and develop joint doctrine, but it lacks the expertise to adequately represent the Corps of Engineers. When seeking assistance, it finds that Army engineers have no standard procedures to ensure that their position is clearly and correctly presented. Joint working subgroups tasked to develop or review doctrine contact different Army agencies depending on the issue. Sometimes they reach the right folks, but often they do not.

Engineer doctrine is written at the Army Engineer School. We must take the lead in joint doctrine development and review. Doctrine developers at the

Joint Warfighting Center, Fort Monroe, Virginia, and working subgroups must understand the process and route all material through the Deputy Chief of Staff for Doctrine at TRADOC, as the Army's single point of contact. They, in turn, should forward material to the Joint Engineer Issues Working Group (JEIWG) at Fort Leonard Wood for coordination among Army engineer organizations and agencies. It is incumbent upon the JEIWG to develop a consolidated response to ensure that pertinent organizations are included in the review process and that disconnects are resolved at the appropriate level. No other engineer agency or organization should speak for the Corps on doctrinal matters.

The Staff Engineer

The positioning of the engineer staff element, both at the joint staff level and within the warfighting CINC headquarters, is broken! We have allowed the staff engineer to be subsumed under the J4, and this is clearly not the most effective organization from the Army's perspective. While the engineer and the logistician are inextricably linked for infrastructure repair and development, the engineer must have visibility across the entire J-staff. He must also have a seat at the head table for planning and conducting joint operations. I believe

By Lieutenant Colonel Robert L. Davis

the engineer function is best executed if the engineer is established as a separate staff element: the J9.

The staff engineer plays a key role in terrain visualization and must have access to the J2 throughout the planning process. Intelligence preparation of the battlefield (IPB) and the engineer battlefield assessment (EBA) must be synchronized and conducted concurrently. Likewise, the staff engineer must work side by side with the J3 and J5 to execute today's campaign and plan tomorrow's. To be effective, the staff engineer must hear the commander's intent firsthand not receive a skewed version from the J4, who listened and noted the key elements with a logistician's ear. He must maximize engineers as a combat multiplier by massing scarce engineer assets at the decisive point(s) on the battlefield and fully coordinating their efforts with the maneuver commander's intent. Most importantly, he must recommend priorities for engineer assets to support both combat and infrastructure requirements.

While there is considerable debate regarding the utility of placing the staff engineer under the J3 instead of the J4, I believe those arguments are seriously flawed. Under the J3, the staff engineer would still be denied a seat at the head table, and the pendulum would shift disproportionately toward combat operations at the expense of building and maintaining infrastructure. We must maintain balance and priorities based on the mission, and we can do that best when the staff engineer is independent.

Command of Engineer Units

If we get the doctrine piece right and place the staff engineer where he can best support the warfighting CINC, then I believe any contentious issues regarding task organization and engineer command will logically resolve themselves. Joint warfighting commands frequently subordinate engineer elements to logistical support commands. Just as Army engineers vehemently resist efforts by logisticians to subordinate the Engineer Command to the Theater Army Area Command, engineers at all levels must maintain maximum flexibility and be equally responsive to both operational and logistical requirements.

The spectrum of responsibility for logisticians is broad enough without adding the burden of commanding large, multifunctional engineer organizations. It is unrealistic to assume that logisticians possess either the technical background or the experience necessary to effectively command and control diverse engineer units. The tempo of modern combat operations and the associated information flow is increasing at an exponential rate. A flat, highly versatile organization is required to effectively respond to the myriad of engineer requirements facing the joint commander. Just as we seek maximum freedom and flexibility for the staff engineer, we must afford the same freedom and flexibility to the senior engineer commanders.

And So...

To best support the warfighting CINC, Army engineers must make three adjustments to our current way of doing business:

- The lead for the development and review of joint engineer doctrine must reside in the Engineer School, and all other agencies and organizations must work through this medium to ensure that engineers speak with a single, united voice.
- The staff engineer requires the freedom to operate as a separate element across the entire staff.
- Command of engineer units cannot be relegated to the logisticians.

Joint doctrine is being written and accepted at a breakneck pace. We must stand up now, speak with unity, and firmly defend our position. Otherwise, engineers will continually chafe at the result and struggle to "make do" when we can least afford it: during the execution of combat and stability and support operations.

Lieutenant Colonel Davis is director of the Department of Tactics, Leadership and Engineering at the U.S. Army Engineer School and serves as the deputy chairman for the Joint Engineer Issues Working Group. As commander of the 43rd Engineer Combat Battalion (Heavy), he deployed the battalion on three occasions as part of a joint task force: once in support of Hurricane Andrew relief efforts and twice to Somalia.

Engineers in Bosnia:

An Overview

By Major David L. Treleaven



In his often-quoted address to a graduating Officer Candidate School class in 1942, Major General Eugene Reybold, the Chief of Engineers, advised engineer officers to cultivate a sense of curiosity and an inquiring mind. "Never pass a bridge without giving thought as to its construction or as to how that particular piece of terrain might best be organized for defense, or as to

how it might best be attacked if it were organized by the enemy."

As we learn more about engineer activities in Bosnia, it is clear that his advice is just as relevant today. The complexity of Operation Joint Endeavor has taxed engineer capabilities and resources, demanding more versatility than any other combat support force in the theater.

Photo by SPC Alejandro Cabello



U.S. Army soldiers from the 502nd Assault Float Bridge Company construct a floating ribbon bridge on the Sava River during Operation Joint Endeavor.



An Abrams M1 tank, with a mine roller attached, searches for mines in a field along Route Ostrich in the zone of separation. The field will be used for a joint military mission.

An example is the 1st Engineer Brigade of the 1st Armored Division. This mechanized combat engineer brigade, which normally has a strength of 800, deployed with 2,400 personnel! It received engineer unit attachments with widely different missions, including assault float bridge, combat support equipment, and power generating companies; fire fighting detachments; combat heavy and corps combat battalions; as well as two U.S. Air Force engineer squadrons and two U.S. Navy construction battalions. The brigade quickly bridged a major river, cleared hundreds of kilometers of supply routes, and employed its engineers in construction missions to sustain Task Force Eagle, the U.S. component of the Implementation Force (IFOR). The challenges ex-

tended to everyone in the command—every sapper, NCO, and officer.

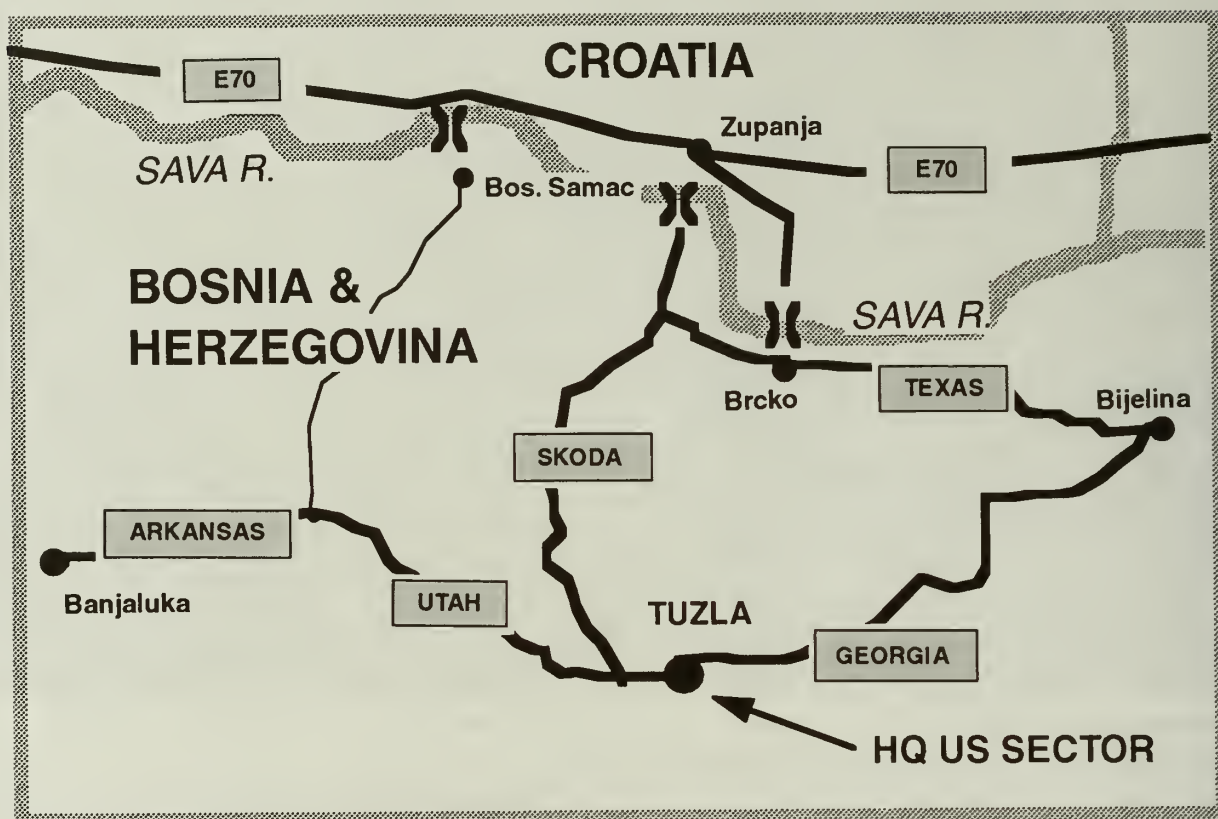
Clearly we cannot cover the breadth of engineer success stories in Bosnia to date nor most of the relevant lessons learned. The information is largely not available, because the key players are still overwhelmed with operational concerns. However, this article presents a summary of accomplishments in the engineer battlefield functions.

Mobility

Bosnia has tested engineers across the full range of mobility missions: bridging, route clearance, route maintenance, countermine operations, and obstacle reduction. Many of the lessons are fundamental. A

moving army needs bridges, and engineers must build, reinforce, or classify them. Battlefields have fortifications that engineers must know how to destroy. In Bosnia, cold temperatures have made these tasks more difficult. Snow must be removed, and frozen ground has caused route proofing to be unpredictable. Bosnia reminds us to heed the basics and train for realism.

Bridging. The greatest single engineer challenge to date was the crossing of the Sava River near Zupanja, Croatia (see map, page 20). This mission was the largest operationally required river crossing since World War II. It was also the first real contingency use of the ribbon bridge. The crossing was conducted under extreme conditions. As engineer equipment was poised to cross, a



thaw caused the Sava's width to swell from 300 to 600 meters. The flood plain where most of the equipment was marshalled became flooded. Despite these handicaps, engineers used Chinook helicopters to deploy ribbon bridge sections into the river while other engineers rebuilt the approaches. Their efforts paid off when the bridge was finally completed at 1000 hours on 31 December 1995. When the water receded, engineers built a causeway across the flood plain.

Bridge-erection boats initially held the floating bridge against the current, but that was a temporary solution. Two float bridges are now anchored in place with a shore guy and boat combination to allow two-way traffic across the river.

Work is ongoing to design a satisfactory semipermanent overhead cable system, but several anchoring systems have been tried already with limited success. Doctrinal and technical publications will be updated to reflect techniques learned and shortcomings identified during the Sava River operation.

The 130th Engineer Brigade now controls the entire crossing operation from a command post in Camp Harmon, on the Croatian side of the Sava River. Two ribbon bridge companies (the 502d from Hanau, Germany, and the 586th from Fort Benning, Georgia) and a platoon from the 535th Combat Support Equipment Company in Grafenwehr, Germany, operate the crossing site.

The Cold Regions Research and Engineering Laboratory deployed a bridge team to Zupanja to research alternatives. Using historical data from the Croatian Hydrometeorological Institute, the lab is developing predictions for when the spring thaw will occur. It is also evaluating an objective method for predicting the thaw.

There are several options for establishing a permanent fixed bridge. One alternative is to hold the float bridge at Zupanja in reserve and construct a Compact 200 bridge at Brcko, Croatia. The Compact 200 is a panel bridge manufactured in Great Britain. Similar in concept to the time-honored Bailey bridge, which is also a British design, it uses

advanced alloys that give it greater strength. An interim solution is to construct a Bailey or medium girder bridge (MGB) at the site. But before new spans can be built, damaged spans must be removed. Sappers from B/23 Engineer Battalion have completed the explosive demolition and cleanup of two spans at Brcko.

Another proposal under consideration is to hire a Hungarian contractor, Hidepito, to construct a combination rail/one-lane-traffic floating barge bridge with a military load class of 100. The proposed site is about 20 kilometers west of Zupanja, at Bosanka Samac. The contractor has arranged to lease the barge system from Hungarian Cold War stocks.

To date, engineers have emplaced a seven-bay MGB and numerous armored vehicle-launched bridges (AVLB) throughout Bosnia. Additional bridges have been brought into the theater, enhancing freedom of movement for both civilians and IFOR units. The AVLB is a real workhorse that is being used to reinforce existing bridges, replace blown bridges, and span dry gaps. Engineers emplaced wooden decks in the open centerline of the AVLB to prevent small cars and horses from falling through.

Engineer soldiers are heavily involved in classifying bridges. They identified bridge reconnaissance as an area that needs more emphasis during the predeployment training at the Combat Maneuver Training Center.

Route Clearance. The engineers' biggest challenge in Bosnia at this time is clearing and proofing hundreds of kilometers of roads and supply routes. Mines continue to be

"This operation has highlighted the need to give engineers a detection capability other than dismantled sappers with hand-held mine detectors."

the deadliest threat to our soldiers. Since the arrival of the IFOR, there have been 14 mine incidents in the theater, 10 of them involving U.S. forces. One incident was fatal, and four others produced serious injuries. Of these incidents, two occurred because soldiers failed to follow procedures outlined during their mine-awareness training. (See article on page 11.)

Zone of Separation (ZOS).

By far the most dangerous mission is the proofing of lanes through the zone of separation (ZOS), a no-man's-land along the confrontation lines between the former warring factions. A commonly heard term is "punching a hole in the ZOS." This is a coordinated operation in which U.S. forces provide security and engineer expertise to the factions who actually clear the mines from roads that cross the ZOS between former front lines. The factions work from their respective sides but, due to distrust, often leave before completing the operations. When they are finished, M1 mine rollers proof the lanes. The "holes" are essential to restore the normal prewar flow of civilian traffic.

U.S. engineers are part of the clearing teams and provide expertise, detection capability, and demolitions. They advise the senior maneuver commander for the clearing operation and provide blades to collapse trenches and bunkers in the ZOS. Because most bunkers are squat, well-built structures that are reinforced by earth revetments, they are not easily reduced. The CEV is extremely valuable in this role since it is an ideal and survivable platform for reducing bunkers and other fortifications. In the 3/5 Cavalry sector alone, engineers have destroyed more than 262 bunkers with the CEV! It is also useful in removing debris in high-threat areas along main supply routes. Engineers have reduced fortifications with demolitions, but using the CEV's main gun has not been authorized.

Countermining Operations.

There are 30 sets of M1 mine rollers and 11 sets of M60 mine rollers in Bosnia. Additional M60 chassis tanks have been deployed for IFOR engineers. When the soil is frozen, it acts as an ice bridge over buried mines, so rollers must make three passes to clear a route. The first pass disturbs or cracks the frozen soil, the second pass ideally detonates the mine, and the third pass proofs the area. However, some mines detonate after the proofing, sometimes even after several other vehicles have travelled the proofed tracks. It is apparent that many mines in Bosnia have deteriorated and their performance is very unpredictable.

This operation has highlighted the need to give engineers a detection capability other than dismantled sappers with hand-held mine detectors.

Vehicle-mounted detection systems and remote detection systems exist but are not yet proven.

The Robotic Technology Insertion Activity (RTIA) at Fort Leonard Wood coordinated the deployment of several pieces of equipment for mobility support and validation in Bosnia. They also conducted predeployment training with USAREUR engineers. The equipment includes:

- *Panther*—a robotic control package for M60 chassis tanks, which are used in a number of applications such as mine rolling and blading.
- *Badger*—a remotely controlled 5-ton truck with full-width mine-detecting coil and a standoff detection and marking system.
- *Miniflail*—a robotic flail that clears a footpath. This equipment has been used by Special Forces and is a veteran of such contingency areas as Afghanistan, Eritrea, and Kuwait.
- *Pointman*—a remotely controlled robot equipped with cameras that allow its controller to manipulate it into tight places to remove or neutralize explosives.
- *Barret .50-Caliber Sniper Rifle*—a weapon for the long-range neutralization of exposed mines and unexploded ordnance.

The 1st Armored Division has established a Mine Awareness Center (MAC), which consolidates faction minefield reports and publishes them for distribution. In the U.S. sector alone, more than 3,700 minefields have been reported. Most of them are concentrated

in an area 2 to 3 kilometers wide along the ZOS. The MAC is tasked to plot untranslated minefield reports which appear on overlays using an entirely different grid system than that used on U.S. maps. Plotting requires a slow manual process of transferring minefields drawn on former warring faction maps to U.S. maps using terrain association.

Snow Removal. In addition to organic graders and bucket loaders, snow plows for the small emplacement excavators (SEE) were sent to Bosnia. UNIMOGS, German trucks similar to the SEE, were also deployed from Germany. Salt spreaders, which mount on 5-ton trucks, are being sent from CONUS.

Counter mobility

Although the primary engineer focus in Bosnia has been on mobility, counter mobility was an early force-protection priority for engineers. Checkpoints had to be built rapidly and manned by U.S. forces. Engineers were key in constructing barricades and mobile obstacles to control the flow of traffic at these checkpoints.

Survivability

Force protection is being done in tiers. Military engineers enhanced IFOR protection with an initial standard of triple concertina and berms around base camps, fuel farms, and key facilities. Towers and bunkers will follow. Engineers executed some sandbagging, but this is largely a unit responsibility.

Sustainment

A wide variety of engineer units have worked around the clock to construct life-support facilities at 23 base camps in Hungary, Croatia, and Bosnia-Herzegovina. A pattern similar to that used in Somalia and Haiti has developed. Military engineers quickly build essential facilities, and the Logistics Civilian Augmentation Program (LOGCAP) contractors under the Brown & Root Services Corporation take over the operation and improve them. LOGCAP contracting activities throughout the theater are managed by the Transatlantic Division of the U.S. Army Corps of Engineers.

Many of the problems that have occurred elsewhere with LOGCAP are being repeated in Bosnia. Often Brown & Root competes with Department of Defense logistics for the same ports, roads, and airfields. Brown & Root personnel experience many of the same difficulties as military engineers. They need petroleum, oil, and lubricants; prescribed load lists; and security. A persistent problem is the lack of a civilian economic base to draw from in Bosnia. Departing United Nations units have often declined to sell their generators, pumps, tools, vehicles, furniture, and fixtures. As a result, Brown & Root has had to bring in equipment they thought would be available in country. In addition, required background checks have slowed Brown & Root's hiring of local nationals.

Despite these problems, living conditions continue to improve for U.S. forces in (Continued on page 29)

Engineer Roles in Stabilizing Haiti



Brigadier General Phillip R. Anderson spoke with Catherine Eubanks about his recent tour as Commander, U.S. Support Group Haiti, and Deputy Commanding General, U.S. Forces Haiti under United Nations control.

Q. When were you in Haiti, and what were your responsibilities there?

A. I was in Haiti from 12 June until 28 November 1995. That was well after the 31 March departure of the multinational forces, led by the United States. With their departure, the multinational forces turned over their duties to the U.N. Mission in Haiti (UNMIH).

While there, I wore two hats. Under the U.N. flag, I served as the Deputy Commanding General of U.S. Forces in Haiti. In that capacity I served as the principal advisor to Major General Joe Kinzer, who was both the United Nations and the United States Forces Commander. My duties for MG Kinzer focused on command matters of admin-

istration, logistics, engineering, discipline and internal organization. In my second job, as Commander of the U.S. Support Group Haiti, I was charged with setting up a self-sufficient organization capable of conducting U.S./Haiti bilateral and U.S. unilateral support missions under an exercise called Fair Winds. Basically, if the United States wanted or needed to provide some type of support not readily endorsed by the United Nations, we tried to provide it through the U.S. Support Group Haiti and Exercise Fair Winds.

Q. What was the United Nations' mission in Haiti?

A. U.N. Security Council Resolution 940 stated that the U.N. mission was to assist the democratic government of Haiti in sustaining a secure and stable environment. This mission was accomplished by providing about 800 U.N.-sponsored civilian police from several nations, who assisted the interim public security force and the Haitian national police. Also, a 6,000-man

multinational military force was used to secure the peace and help establish an environment conducive to the conduct of free and fair elections—free of intimidation, with readily identifiable polling places, and workable administrative and logistics support systems. The UNMIH mission also included protecting international personnel and key installations. For example, we protected ambassadors and consulates and key installations like the presidential palace, the international airport and the international seaport. Finally, the UNMIH mission included training a new Haitian national police force. That program eventually resulted in fielding about 5,000 new police officers. All of them were trained in Haiti and about 2,900 also received training here at Fort Leonard Wood.

Q. Can you explain the U.S. unilateral mission?

A. The Support Group Haiti mission was to provide additional U.S. support, not sponsored or resourced by the U.N., through a METL (mission



Air Force REDHORSE engineers renovated the outpatient clinic of the hospital in Port-au-Prince. These hardback tents were used by hospital personnel during the renovation. The same design was used to house engineers at their base camp.

essential task list) oriented overseas deployment-for-training exercise called Fair Winds. The intent was to provide appropriate units (like engineer, medical or aviation units from all services) with quality training opportunities while simultaneously assisting the government of Haiti in strengthening its fragile democracy.

Q. *What engineer capabilities were in Haiti to support these missions?*

A. Let me answer that in two parts. First, under the U.N. flag, there was the Canadian-American Engineer Battalion, called the *Can-Am Engineer Battalion*. In that combined unit, the United States provided the battalion-level command and control and the horizontal construction capabilities while the Canadians provided the vertical construction capability. The U.S. units in the Can-Am Battalion initially included the 92d Engineer Battalion from Fort

Stewart and, later, the 46th Engineer Battalion from Fort Polk. Brown & Root, also under the U.N. flag, provided additional engineer expertise. They were under contract with the United Nations to perform engineering services and to provide logistical support to the deployed force.

Under the U.S. Support Group Haiti, there were significant engineer capabilities. The joint engineer staff included an Air Force lieutenant colonel, who directed the engineer staff; a Navy lieutenant commander, who handled all of the real estate actions, design concepts, cost estimates, and contract administration; and an Army major and several captains and noncommissioned officers, who had project management responsibilities. About 150 Air Force REDHORSE personnel provided both horizontal and vertical construction capabilities; later they were joined by about 100 Navy Seabees with both horizontal and vertical construction skills.

Q. *How did engineers contribute to the U.N. mission?*

A. I should address the engineers' contributions in terms of overlapping phases. The first phase of work under the U.N. flag largely focused on force-protection measures. Engineers made sure that the base camps and key installations were constructed properly to protect the force with the right kind of guard posts and bunker facilities. Force-protection measures later included expedient repairs to selected infrastructure to avoid potential crisis situations. Repairs to the prison in Port-au-Prince was one example. We found the prison to be in a horrible state of repair. Unless we improved the lighting, security, and water and sanitation systems, U.N. forces would constantly face the potential for prison riots. Engineers under the U.N. flag were placed in that prison, where they made expedient and rudimentary repairs to stabilize the situation and thereby reduce the likelihood of a prison riot.

After force protection, the next phase focused on force beddown. The Can-Am Engineer Battalion did most of the force beddown construction at multiple base camps around the country. Their work was supplemented by Brown & Root under contract with the United Nations. Brown & Root personnel usually made improvements to the base camps built by the Can-Am engineers. For example, they improved water-distribution and sanitation systems and installed air conditioners in some dining facilities and recreation centers to improve our foxholes, so to speak, and make the base camps more liveable.

The third and final engineer phase to the U.N. mission I should highlight is the contribution of civil-affairs projects. Engineers made significant improvements to roads, bridges, and water-distribution

systems. They provided expert advice and counsel to officials of the Haitian government responsible for power generation, reforestation, sanitation, and public safety. After meeting the force-protection and force-beddown requirements, engineers completed many civil-affairs projects to support the long-term security and stability of Haiti.

Q. *How did the tasks completed by the U.S. Support Group Haiti differ from those already discussed?*

A. Engineers not under the U.N. flag had a somewhat different mission. Recall, their mission was to provide U.S. support while hosting overseas deployment-for-training opportunities that would assist the emerging democratic government of Haiti. The first thing the U.S. Support Group Haiti did was to construct a base

camp to accommodate incoming U.S. forces. They included engineers, aviators, and some logisticians, with plans to accommodate some follow-on medical units.

After the base camp was constructed, projects to be performed were largely negotiated with the government of Haiti. For example, the Haitians would identify a candidate project to meet some emergency infrastructure requirement, such as a road, bridge, school, or hospital. The units scheduled to deploy and work under U.S. Support Group Haiti then compared the candidate projects with their training requirements. After matching a Haitian infrastructure requirement with a METL-oriented unit training requirement, we proceeded with preliminary designs and cost estimates. Eventually this led to a government-to-government agreement defining



Photo by 1LT Jason Smallfield

U.N. engineers replaced the bridge on a road near Jacmel, which was destroyed in a hurricane. Here, soldiers from the 92nd Engineer Battalion, Fort Stewart, demolish the old bridge abutments to make way for the new construction.



Air Force REDHORSE units renovated six schools in Haiti. Here, airmen construct the floor for a new building at the Peru School after the old building collapsed.

project scope and funding requirements.

As a result of this negotiated approach to projects for the Support Group to execute, engineers completed a \$500,000 hospital renovation in Port-au-Prince. This renovation greatly improved the hospital's outpatient service. They also renovated six schools in Port-au-Prince at a cost of \$330,000.

Incidentally, materials for the hospital and the schools were funded by the U.S. Government. Once we demonstrated the capabilities of U.S. military engineers to assist the government of Haiti, we hoped that international donors would offer to fund future worthy projects to keep our military engineers gainfully employed. We were successful with this strategy. After demonstrating our skills in the hospital and school projects, the Inter-American Development Bank contributed \$1 million toward a four-lane concrete highway through one of the worst parts of Port-au-Prince, right along the waterfront. Other projects on the horizon for international funding included water wells and additional school renova-

tions. So a combination of U.S. and international funding allowed the Support Group to make the best use of the military engineer talent sent to Haiti for training and to complete emergency infrastructure repairs.

Q. Were you able to avoid mission creep while completing the additional projects?

A. Mission creep was not a problem because the deploying engineer units typically rotated to Haiti for 6 months and therefore negotiated a 6-month package of projects to complete during their deployment. When units had unexpected delays in acquiring materials or support, we would determine how to best complete that project—either by extending the unit's time in country or by passing the remainder of the work to a follow-on unit. But units were able to complete most of their projects during their training period.

Q. In other words, units could select the kinds of projects they wanted to accomplish?

A. Exactly. The saying that "everything in Haiti is broken except for the human spirit" is true. With so many projects needing to be done, it was easy to match candidate projects with unit training requirements. The real issues became how to best fund projects and acquire the materials to accomplish them quickly.

Q. Was the end state clear before you went to Haiti, or were you instrumental in developing it?

A. For the United Nations, the end state was very clear. As mentioned earlier, the U.N.'s mission statement was spelled out in a Security Council resolution. But there was no clear end state for the U.S. Support Group, because one of our objectives was to maintain a U.S. presence in Haiti after the United Nations' planned departure. Our intent was to demonstrate the continuing interest of the United States and our continuing concern for Haiti's growth and progress toward becoming a stronger and more self-sufficient democracy.

Q. *Do you have some insights or lessons to help engineers involved with peacekeeping operations?*

A. I don't have any new lessons or new insights, but I have some relevant observations. The first deals with the importance of joint engineer doctrine and our need to clearly understand joint engineer operations. Here at the Army Engineer School, we are working hard with the other services to establish joint engineer doctrine for contingency operations. That doctrine must address command and control relationships as well as staff relationships. For example, should there be an independent engineer on every joint staff, or is it OK for the staff engineer to work for the senior staff logistician or someone in the staff operations chain? The consensus here tends to be that an independent engineer staff officer needs to answer to the commander and that we need to retain independent command and control of our engineer organizations to be more responsive to the commander.

Another observation from Haiti concerns the value of multinational engineer operations. Canadian engineers brought fantastic talent to the construction requirements in Haiti. Their vertical construction skills far exceed those of our combat heavy battalions. That is largely because of the Canadians' intensive training programs and because they have journeyman-level expertise in their junior grades.

Another observation pertaining to peace operations is the value of seeking coalition project support and sponsor-

ship versus just national sponsorship. There are many opportunities to use the resources of organizations like the World Bank or the Inter-American Development Bank to fund military engineer training projects. In the future we could propose that the United States provide the military personnel and equipment, construct the base camp, provide the design and project management, but request a cost-sharing arrangement with non-U.S. sponsors to purchase required materials and fuel. That proved to be a cost-effective way of sponsoring some projects in Haiti. As a result, U.S. military units acquired significant training benefits without prohibitive costs to the U.S. Government. We should pursue this resourcing method in future operations.

It was evident to me that the engineers always provided a visible measure of progress in Haiti. That was important as we tried to assess if we were making any progress in helping to establish a more secure and stable environment. Sometimes it was difficult to see something visible or tangible that signified a major improvement. Tangible results were evident after parliamentary elections were held, and we could see progress after a significant number of new Haitian national police were fielded. But on a regular basis, the Haitian people and many international observers measured progress through our engineer projects. They could see how a renovated hospital or school represented tangible and real progress. Frequently large crowds would surround our projects to watch the work in progress and imagine the

benefits they would gain in the future.

I can't overemphasize the importance of prioritizing the engineer effort. With more projects in Haiti than we could ever complete, we had to evaluate construction requirements and select projects with the greatest payoffs. We always focused on work we were capable of doing that had the greatest benefit to the overall mission.

Let me speak briefly about preparing for military operations other than war or what we now refer to as stability and support operations. Army engineers must continue to train on their wartime METL. This is the training necessary to be successful in peacemaking, peacekeeping, and humanitarian relief operations. We hear a lot of discussion about the need to change our wartime METL to accommodate peacetime operations. I say "no." Simply continue to focus on the wartime METL and temper it with a good understanding of the rules of engagement and some appropriate situational training exercises. That regimen will best prepare engineers for all future contingencies.

I might just conclude by saying that engineers really did make a major contribution toward the long-term security and stability of Haiti and that engineers are a major contributor in these kinds of contingencies toward winning and maintaining peace.



Brigadier General Anderson is the assistant commandant of the U.S. Army Engineer School. He previously served as Fort Leonard Wood's chief of staff and director of training, and as commander, 36th Engineer Group, Fort Benning, Georgia.



CTC Notes



Battle Command Training Program

By Lieutenant Colonel Greg Stanley and Major Dave Snodgrass

Assistant Division Engineer (ADE) Responsibilities. The ADE is the division engineer's primary point of contact on functional matters concerning division plans and current operations cells. Many ADEs get drawn into fighting current close and rear operations and fail to ensure that engineers are integrated into future operations. Other ADEs are so focused on future

operations that they fail to maintain adequate information on current operations. The ADE must determine how he will synchronize with the engineer brigade (or battalion) main command post (EMAIN CP). One technique is for the EMAIN CP to maintain information on current operations and routinely update the ADE section (normally NCO duty). Often, ADE NCOs are valuable resources that are not used. Their duties should be defined and should include:

- Maintain overlays and status charts.
- Prepare graphics.
- Assist during war gaming.

The EMAIN CP also can assist the ADE by providing current, routinely updated enemy and friendly capabilities and intelligence products. For example, the EMAIN CP may provide the ADE with current obstacle templates based on recent intelligence and enemy capabilities. Most units pass raw data, which forces each recipient to determine the enemy capabilities.

Some units have integrated their EMAIN CP into the division main (DMAIN) CP. The advantage of this organization is that it allows the ADE to focus on plans while the EMAIN operations cell maintains current operations. This organization maximizes the efficiencies of both groups. It also has some disadvantages:

- It is personality dependent. The engineer commander may want a separate CP or the division may not want to expand the size of the DMAIN.
- Once integrated, the capability and expertise of the EMAIN CP to operate as a separate command post are potentially lost when it is assigned a separate engineer mission, such as a division river crossing.

Intelligence Preparation of the Battlefield. Engineer units are expanding their capability to determine and template enemy engineer activity through use of the All Source Analysis System (ASAS). An intelligence information management system, ASAS allows S2s access to intelligence reports from multiple sources. It allows engineer brigade S2s to conduct a word search through all reports received over a period of time. By identifying key words such as "engineer", "GMZ mine-layers," and "pontoon bridge" they get a list of all reports containing those words. Then the S2s conduct analyses to determine what enemy engineer units are in their sector and template their activities.



National Training Center

By Major Tom Buning

Defense Preparation. "Engineers execute while the maneuver force they support prepares." As a result of this philosophy, the time lines prepared by engineers often are not synchronized with those prepared by the

maneuver force. FM 5-71-3 states that engineers need to take the lead in forcing this issue to successful resolution. The tasking for maneuver commanders and their supporting engineers to coordinate thoroughly must identify specific link-up times and locations in the main body of the higher headquarters' operations order. Engineer planners must ensure that maneuver planners insert this directive in the main body of the operations order.

There is no substitute for making this tasking a written order of the higher headquarters' commander. Clearly stating this tasking will ensure that subordinate commanders and their engineers are on the ground early to develop the engagement area. The cost of not doing so is the loss of critical execution time needed for engineers to conduct countermobility and survivability work. When done correctly, engineers will create defensive preparation time lines that allow for the maximum use of the time available. They will use this time to build an engagement area where obstacles are properly integrated and vehicle fighting positions are properly sited.

(Continued from page 22)

Bosnia. Through the combined efforts of military engineers and LOGCAP, billeting and dining facilities were constructed for nearly 18,000 personnel. Billeting facilities range from "hard-back" general-purpose, medium tents with plywood flooring to fixed, permanent structures and modern modular living units housed in 20-foot shipping containers. Showering and ablution facilities range from those connected to existing sewer systems and featuring hot water to Australian showers and outhouse-type latrines.

Across the U.S. sector, moving and resupplying Class IV construction materials is an engineer responsibility. The 1st Armored Division's main support battalion and the brigade's forward support battalions have not been actively involved in allocating or transporting this class of supply. Although not

doctrinally an engineer mission, engineers frequently become involved in hauling Class IV supplies by default. If this mission becomes the norm in contingency operations, then we must recognize that the engineer's organic transportation assets are inadequate.

Conclusion

U.S. Army engineer challenges in Bosnia are enormous. We have demonstrated tremendous versatility in accomplishing a wide variety of missions, to include bridging, route clearance, technical reconnaissance, countermine operations, base camp construction, snow removal, Class IV resupply, and route maintenance.

Even greater challenges are in store. After four years of war, Bosnia's roads, bridges, and highways are in a deplorable

condition. Additional wear and tear from convoys of heavy military vehicles will accelerate the damage. Maintaining our ability to resupply our forces and enhancing freedom of mobility for civilians will be a critical engineer mission in the future.



Major Treleaven is chief of the Combat Engineer Branch, Department of Tactics, Leadership and Engineering. He served as platoon leader and company XO in the 41st Engineer Battalion, 10th Mountain Division. He commanded D/9th Engineer Battalion during Desert Storm and served in Somalia. He served with the U.N.'s Bosnia-Herzegovina command in Sarajevo. Major Treleaven holds a bachelor's degree in electrical engineering from Carnegie-Mellon University, Pittsburgh, Pennsylvania.



Building a Bunker/Trench Live-Fire Complex in Korea

By Captain Raymond E. Hart

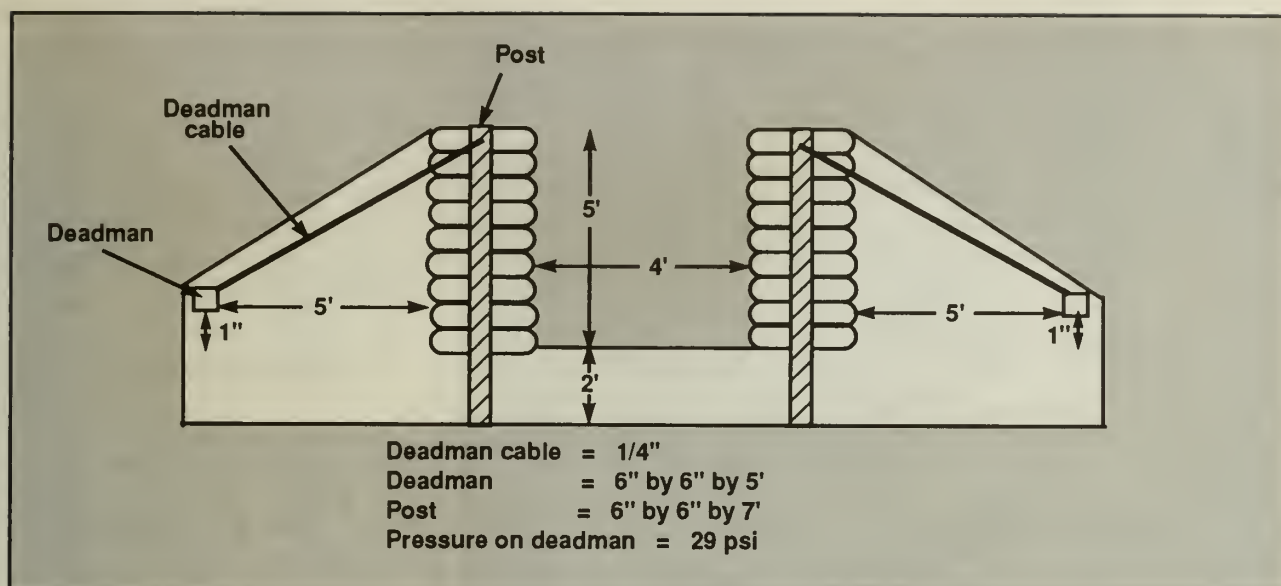
Within the 2d Infantry Division in Korea is a unique organization—the 2d Brigade Combat Team—consisting of the 1/9 Infantry Battalion (Mechanized) and the 1/506th and 1/503rd Infantry Battalions (Air Assault, Light). The mission of the two light battalions requires extensive dismounted operations that include clearing prepared enemy defensive positions, such as extensive trench lines and bunkers. In the past, situational training exercises of this type required recurrent construction of small trenches, which the infantry cleared with grenade simulators, blank ammunition, and percussion grenades. The small trenches caused several train-

ing problems that impacted on the unit's wartime readiness:

- Hastily dug trenches and bunkers were not suited to heavy use during multiple iterations by a battalion-sized element.
- Temporary trenches required large amounts of manpower for construction and time for repairs, adversely affecting the training cycle.
- Practice trenches did not meet safety requirements necessary to conduct realistic live-fire exercises.

Since the 2d Infantry Division needed a permanent facility to train bunker and trench-clearing operations, the 2d Brigade Combat Team was

challenged to produce a conceptual design and overwatch the construction. The team commander wanted a tactical scenario that provided an enemy defensive position with trench lines and bunkers suitable for use by squad-sized through company-sized units. The complex would provide an opportunity to exercise small-unit command and control and direct-fire coordination and offer a safe environment for throwing live grenades. The facility would be located in Cherokee Valley, part of the Eighth U.S. Army (EUSA) multipurpose range complex, approximately 17 kilometers west of Chongok. In February 1995, EUSA provided funds and resources for the construction.



Cross section of a representative trench

Mission Objectives

The complex was constructed by B Company, 2d Engineer Battalion, 2d Infantry Division, assisted by the 82d Combat Support Equipment (CSE) Company, elements of the 2d Korean Service Corps Company, and platoons from the 1/506th and 1/503rd Infantry Battalions. The original specifications required two trench lines with a single interconnecting trench. The trench system included six bunkers and numerous target wells. To turn the concept into a reality, they—

- Developed a safe design for a live-fire complex with interconnecting trenches.
- Used discarded vehicle tires as the primary construction material.
- Organized the soldiers to efficiently accomplish the mission.

Because of the complexity of the project and the number of agencies and personnel involved, the mission objectives were divided into two phases.

Phase I consisted of gathering information and conducting an initial reconnaissance. The information required included the conceptual design, the bill of materials, and the safety requirements outlined by the division safety office and range control. Phase II consisted of a detailed reconnaissance with all the key players to finalize the site layout, tactical scenario, structural design, and safety requirements.

Design and Planning

The design linked the requirements of the tactical scenario, training objectives, and safety requirements to the realities and constraints of the available terrain and material. The two main trench lines were on level ground, running along the hillside. The interconnecting trenches ran up and down the hill between the upper and lower trenches, an approximate elevation difference of 16 feet. The bunkers were 5 feet by 4 feet, small enough to contain the blast of a fragmenta-

tion grenade. A small opening in each bunker allowed grenades to be thrown inside. Built with durable, blast-resistant tires filled with soil, the bunkers will withstand numerous blasts.

The trenches have 5-foot-high tire walls supported by 6-inch by 6-inch posts and deadmen (see photo and figure). Used tires provide a readily available and free building material that will hold up under live fire. Conventional construction materials—lumber, plywood, nails, and bolts—were unacceptable for several reasons. An extremely expensive building material in Korea, lumber splinters easily when hit by live grenades and small-arms ammunition and requires extensive and costly repairs. In addition, the nails and bolts holding lumber in place create a safety hazard from ricocheting munitions.

Tire preparation was a critical task and a choke point. Work crews separated the tires by diameter and packed the tire walls with soil before putting them in place. Every third



View of upper trench with walls at one-half their finished height. Notice that every third stack of tires is supported by a post.

stack of tires was supported by a 6-inch by 6-inch by 6-foot 6-inch post. They were driven 2 feet into the ground and secured with a 1/4-inch cable attached to a 6-inch by 6-inch by 5-foot deadman buried adjacent to the trench. Intermediate stacks had U-shaped pickets to provide rigidity and support to the wall. Using 16-gauge wire, a separate crew laced every tire to those above and below it and to the tire on each side.

Since Korea receives heavy monsoon rains in the summer, adequate drainage was a major consideration in the facility design and construction. To aid with runoff, they built trenches on a 2-percent slope leading to french drains that transported water under the trench walls to a nearby stream. Each trench was lined with gravel to facilitate runoff and add solid footing. An intercepting ditch on the upper slope of the trench lines mini-

mized runoff from the valley walls.

The unit developed an initial activities list and an estimate sheet for each activity. Since standard work rates for this type of construction were not available, initial work rates were based on estimates and verified during construction. B Company discovered that troop efficiency fluctuated constantly because of weather, work-crew experience, terrain, and the length of work periods. The critical path method (CPM) required daily updating as time estimates were verified and variables changed.

Design adjustments were made based on guidance from the 2d Brigade Combat Team, the division G3 and safety offices, and the materials available. The changes maximized safety and training benefits and resulted in a design that exceeded the original request. The final design included a 328-foot (100-

meter) upper trench, a 246-foot (75-meter) lower trench, seven bunkers, and more than 328 feet (100 meters) of interconnecting trenches. The completed trench complex can provide scenarios for live-fire exercises for squad- through battalion-sized units.

Challenges

Several challenges unique to the project required innovative solutions. First, B Company had to complete a section of the trench and several bunkers by mid-April so the 1/503rd Infantry and the 2d Infantry Division safety office could proof the design. Proofing went well because the sunken bunker floor greatly reduced the grenade blast angle, allowing very little shrapnel to exit the bunker.

The next challenge was to interconnect the trenches. With the 16-foot elevation change, interconnecting the trenches required stairs. Because of the size, shape, and slope of the site, traffic required careful monitoring. The 82d Combat Support Equipment Company constructed several terraces between the upper and lower trenches to facilitate backfill operations and spoil removal. Equipment was kept away from the newly constructed trenches to avoid digging up the deadmen or collapsing the trench walls. The slope and limited work space required skilled supervisors and operators, who had to be cognizant of their location and objectives at all times.

Using tires as the primary construction material presented the greatest challenge. Since

no single tire size was available in sufficient quantity to complete the entire project, tires were sorted by size and serviceability. Tire availability constantly affected the work rate and occasionally caused minor design modifications. When the local supply fell short of the requirements, the Korean Army allowed access to its stockpiles.

The construction site was characterized by rocky and often frozen soil. Since the small emplacement excavator (SEE) could dig in these harsh conditions with relative ease, it was used to dig the bunkers and backfill the trenches. It could maneuver into tight areas and dig with near-perfect precision. The SEE could backfill in the trench line with such speed that one hour of work with the SEE equalled one platoon hour of manual backfilling.

The SEE's pneumatic tools and front bucket were also valuable tools. The pneumatic clay spade dug postholes in rocky soil where it was almost impossible to dig by hand. Even though the front bucket is not capable of digging, it scooped up gravel, sand, and dirt from loose piles and transported them around the project site, eliminating numerous man-hours. On the job site, the bucket transported other construction materials, such as tires, wire, and lumber.

Lessons Learned

B Company learned several lessons from this project that may apply in similar situations:

Time Estimate. The limited time allocated for the project from conception to completion was a hard obstacle to overcome. Planning time was insufficient to ensure that the proper resources were available and the designs approved. The CPM must be a flexible working document that is updated daily to reflect work-rate changes. B Company was overly optimistic about the work rates and troop efficiency and should have devoted more time to ensuring accurate work-rate estimates. Activity estimate sheets and the CPM must be adjusted quickly so resource constraints can be identified immediately.

Materials. Materials must be on-site quickly to avoid a resource constraint. Having the material early allows the flexibility to begin an activity sooner than planned.

Crew Hours. Work-crew rest must be incorporated into the plan. Initially, B Company worked long hours to meet the completion date. Combined with night guard duty, this greatly reduced troop efficiency. Once identified as a problem, adjustments were made and overall efficiency rose considerably.

Customer Involvement. All key personnel—the constructing units, the user, the bill payers, the safety office, the unit responsible for ownership and maintenance, and higher headquarters involved in the approval decision—must participate in both the reconnaissance and the site layout. The customer must be involved in the project from design to completion, since an involved customer is a satisfied customer.

Design. The bunkers and trenches were designed to withstand heavy use and require minimum maintenance. Although using tires as the major construction material presented problems, they were the best choice considering the safety and maintenance requirements.

Conclusion

From November 1994 to April 1995, the EUSA bunker/trench complex went from concept to reality. From carving the site from a rugged, rocky valley to collecting the tires, no task proved insurmountable for the soldiers. The bill of materials included more than 16,000 tires, 4,500 feet of cable, 250 posts, and more than 3,000 sandbags. The project consumed 35,000 man-hours and 14,000 vehicle miles. In two months, a valley was turned into an extensive live-fire range that will help train the soldiers of the 2d Infantry Division. It was the sweat and muscle of a combined arms team—U.S. Army engineers and infantry and the Korean Service Corps—that successfully created the largest live-fire bunker and trench complex in the Army.



Captain Hart serves as commander of Bravo Company, 2d Engineer Battalion, 2d Infantry Division, Korea. Previous assignments include lead analyst, Department of Construction Engineering, U.S. Army Engineer School; and construction officer, 2d Infantry Division Engineer Brigade, Korea. CPT Hart holds a bachelor of science degree from Southern Illinois University.

Modernized Demolition Initiators

By Rebecca Johnson

Modernized Demolition Initiators (MDI) is the project name given to a new field of nonelectric blasting caps and associated items being introduced this summer. MDI will be used to initiate standard military demolitions and special charges. It will supplement and partially replace the M7 nonelectric blasting cap, the M6 electric blasting cap, and the detonating cord.

MDI, which is currently undergoing final testing and type classification, will give the soldier a safer, easier, and faster method of accomplishing demolition missions. The snap-together components of MDI simplify initiation systems and some types of explosive priming. MDI will also improve demolition initiation reliability and safety. One reason for the improved reliability is that all of the components are sealed and, unlike standard nonelectric-priming components, cannot be easily degraded by moisture.

The Modernized Demolition Initiators are:

- Nonelectric Blasting Cap, 30-Foot Shock Tube - XM11
- Nonelectric Blasting Cap, 500-Foot Shock Tube - XM12
- Nonelectric Blasting Cap, 1,000-Foot Shock Tube - XM13
- Nonelectric Blasting Cap, Delay - XM14
- Nonelectric Blasting Cap, Delay - XM15
- Blasting Cap and Shock Tube Holder - XM9
- Time-Blasting Fuse Igniter With Shock-Tube Capability - XM81

Shock Tube

The shock tube is a thin, plastic tube of extruded polymer with a layer of special explosive material deposited on its interior surface. This special explosive dust propagates a detonation wave. The wave moves along the shock tube to a moisture-resistant blasting cap that is factory crimped and sealed. The detonation is normally contained within the plastic tubing. The shock tube offers the instantaneous action of electric initiation without the risk of accidental initiation of the blasting cap (and the charge) by nearby radio transmitters or static electricity discharge.

The XM11 nonelectric blasting cap with a 30-foot shock tube. Six XM11s are shipped in each box.

Blasting Cap

Military explosives require a substantial shock to be initiated. This shock is normally provided by a high-strength blasting cap, the nonelectric M7, or the electric M6. They will be replaced by three new high-strength MDI blasting caps—XM11, XM14, and XM15—and two low-strength blasting caps—XM12 and XM13.

Blasting Cap Holder

Plastic blasting cap holders allow several shock tubes to be connected to a high-strength XM11 or XM14 blasting cap. The XM9 holder helps secure up to five shock tubes to the high-strength detonation of an XM11 or XM14 blasting cap. The XM9 holder also can be used to connect the XM11 or XM14 blasting cap to the detonating cord.

Time-Blasting Fuse Igniter

A new, more powerful igniter will initiate the shock-tube ends of the new blasting caps. The XM81 is almost identical to the older M60 igniter, except that the XM81 has a screw-end cap and a shipping plug and accommodates either the thin shock tube or the M700 standard-diameter time-blasting fuse.

With the type classification and doctrinal manuals finalized, new equipment training teams will train units from May through August 1996.

Mrs. Johnson is the chief, Combat Engineering Branch, Engineering Division, Department of Tactics, Leadership, and Engineering, U.S. Army Engineer School. She is a graduate of the University of Missouri at Rolla, where she received a master's degree in engineering.



The AVLB:

Still a Viable Mobility Asset

By Second Lieutenant Robert Dieter

In July 1995, U.S. Army engineers provided support to the Marine Corps during Operation Freedom Banner in the Republic of Korea. Marines stationed in Okinawa traveled to the eastern seaport of Pohang to exercise their sea-stationed equipment. Army combat engineers from the 2d Engineer Battalion of the 2d Infantry Division provided mobility support along the routes used during the exercise. The mission proved to be an educational experience for both the Marine and the Army engineers.

During the initial reconnaissance of the route to the MIAI training range, the III Marine Expeditionary Force (MEF) discovered a military load classification 18 bridge that had neither a bypass nor a ford site. An Army combat engineer team from Charlie Company, 2d Engineer Battalion, conducted a bridge reconnaissance to determine the options available to cross the Marine's MIAI tanks and supporting equipment. The concrete bridge spanned a gap of 41 feet with a 5-foot-2-inch abutment at each end. The bridge had an 8-inch rise in the center to allow water to run off. The team determined that, if cribbed, an



Top photo: The rehearsal—An M1 on the approach platform. The rehearsal validated the cribbing and ramp design while building the M1A1 crew's confidence.

Bottom photo: The crossing—An M1 successfully mounts the AVLB while Army engineers closely monitor the bridge.

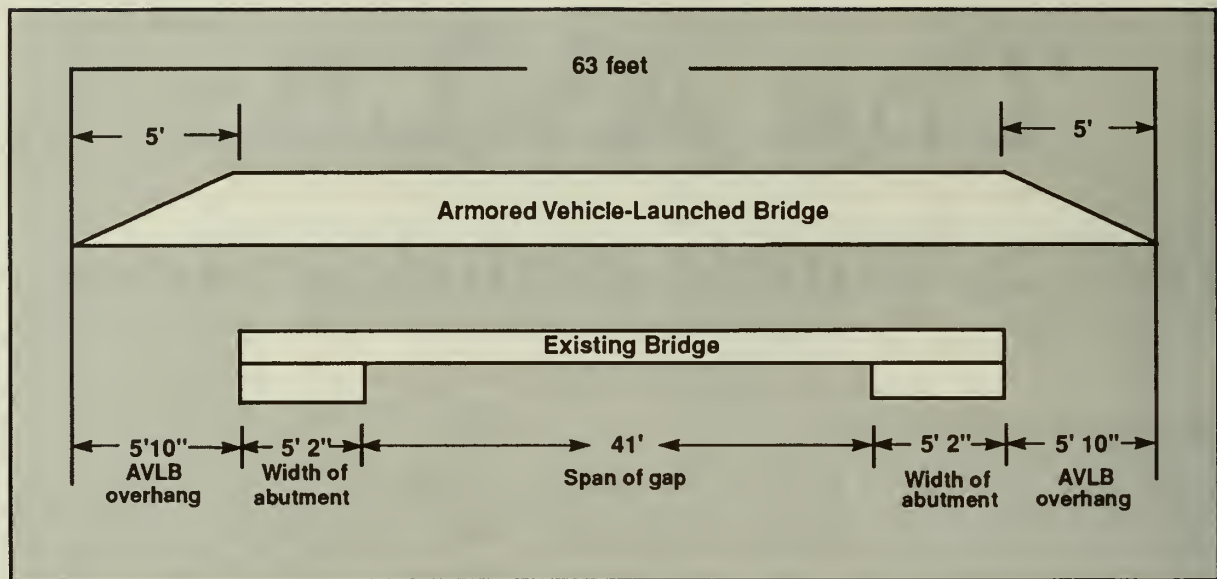


Figure 1. AVLB versus existing bridge dimensions

armored vehicle-launched bridge (AVLB) could span the gap, enabling the Marine detachment to cross. Figure 1 shows a comparison of the existing bridge to the AVLB.

The AVLB is a 15-ton aluminum alloy bridge mounted on a 48-ton M60 chassis. It is designed to cross vehicles up to 60 tons over a 60-foot gap. With the development of the 67-ton M1A1 Abrams tank, the AVLB was approved to cross vehicles up to 70 tons in a "caution crossing" over a 50-foot gap. However, the following stipulations exist when crossing vehicles weighing more than 60 tons:

- Vehicles must not stop on the bridge. Movement prevents the full weight of the vehicle from occupying the same space, which could cause the bridge to buckle.
- Vehicles must not turn or adjust their alignment on the bridge. The ground guide must have the vehicle lined up properly before

it drives onto the bridge. This is particularly important for tracked vehicles because steering them on the bridge might cause the turning tracks to tear up the bridge panels.

- All four center pins of the bridge must be in place to provide additional stability. This stability is needed to decrease the amount of deflection that occurs as the vehicle approaches the bridge's center of mass.

Two AVLB teams from Charlie Company, 2d Engineer Battalion, provided mobility support for the III MEF. After conducting their own evaluation of the bridge site, the AVLB teams linked up with the Marine engineer officer in charge to discuss the cribbing requirements. They determined the rise of the existing bridge then consulted the operator's manual and estimated that the AVLB would deflect from 2 to 5 inches when an M1A1 reached the bridge's

center of mass. They decided that the cribbing should rise 16 inches above the ground level to provide a 3-inch safety factor. Both ends of the AVLB required cribbing. The final cribbing was 3 feet wide and spanned the width of the bridge. Marine and Army engineers constructed two sets of cribbing by modifying 8x8x10, 8x8x16, and 8x8x20 dressed timbers. They banded both sets together to restrict movement when the M1A1s entered and exited the bridge. Banding also allowed material-handling equipment to rapidly emplace and remove the cribbing.

The next challenge was to get the Abrams tanks up to the level of the bridge, which was now elevated 16 inches. The AVLB operator's manual calls for a 3-foot gap between the beginning of the bridge and the cribbing. Using a straight ramp from the ground to the elevated bridge caused concern for two reasons:

- As a tank drove onto the bridge, it could shift the

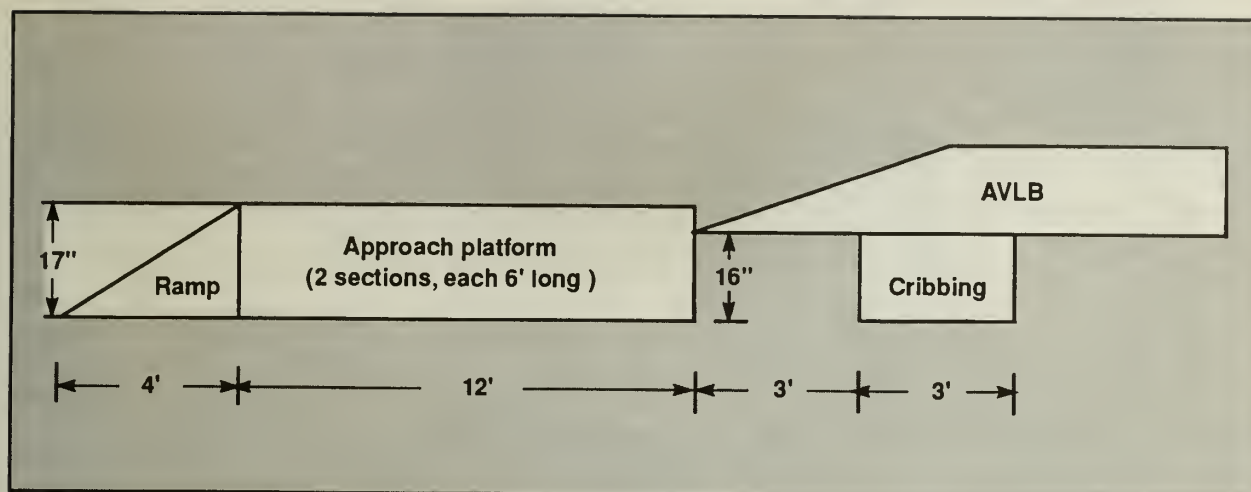


Figure 2. Entrance ramp, platform, and cribbing dimensions

bridge forward and create a gap between the ramp and the AVLB. The gap would grow larger as each tank crossed.

- If a gap was created, the weight of an approaching M1A1 might use the cribbing as a fulcrum and cause the bridge to see-saw.

To alleviate these concerns, the engineers constructed an approach platform long enough to hold most of a tank before it crossed the bridge. The platform was slightly higher than the 16-inch cribbing. They incorporated the added height for the approach platform so the M1A1 would come down on the entrance ramp of the AVLB instead of meeting the forward edge of the bridge head-on. This reduced the risk of the tanks pushing the bridge forward and lessened the shock on the tie-rods located at each end of the bridge. Based on these considerations, they constructed the approach platform in two pieces. They banded each section together

**“Operation
Freedom
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to prevent the lumber from shifting and to assist in rapid emplacement and removal. An exit platform was not required because the bridge would not shift as a tank exited. The completed approach platform was 12 feet long and 17 inches high and spanned the width of the bridge.

The engineers constructed two ramps: one to bring the tank onto the approach platform and a second to bring the

tank off the bridge at the same declination. Both ramps were modified 8x8x10 lumber planks stacked to an incline and decline, respectively. The exit ramp was 2 feet longer than the entrance ramp because there was no exit platform; the extra 2 feet were required to maintain the same declination slope. Figure 2 shows the final plan for the cribbing, platform, and entrance ramp.

After the engineers completed the construction, they conducted a rehearsal to measure the actual deflection of the AVLB as the tanks crossed and to see how the M1A1 crews handled entering and exiting the bridge. Front loaders moved and shifted the heavy cribbing bundles, approach platforms, and ramps into place. Once the cribbing was set, the AVLB launched the bridge on the cribbing and moved to a secure location so the platform and ramps could be emplaced. After the engineers completed the set-up, they ground-guided each tank across the bridge. They crossed

seven tanks during the rehearsal with an average of 3.5 inches of deflection, measured with the tanks at the bridge's center of mass and the center pins inserted. The greatest deflection was 4 inches and the least was 2.75 inches. The rehearsal verified the planning factors and allowed the MIA1 crews to gain confidence and experience in crossing a gap on an AVLB. They detected no problems during the rehearsal, and the AVLB had no problems launching and releasing the bridge, in spite of having to launch onto the 16-inch cribbing.

The crossing for the exercise took place at midnight to minimize disruption to civilian traffic. Initial planning called for a 4-hour window of operation. Due to the close coordination of Army and Marine engineers and the full-scale rehearsal, it took only 55 minutes to emplace the cribbing, launch the bridge, cross the MIAs, and remove the bridge and cribbing. The time was reduced to 41 minutes during the return crossing.

Combat engineers of the 2d Engineer Battalion were continuously challenged by Korea's mountainous terrain and the lack of fording sites

at streams and rivers. However, crossing the Marine detachment gave them valuable mobility experience. More importantly, Operation Freedom Banner clearly demonstrated that the AVLB is still an effective tool for mobility operations.



Second Lieutenant Dieter is the Assault and Obstacle Platoon Leader of C Company, 2d Engineer Battalion, Republic of Korea. He is a graduate of the Engineer Officer Basic Course, Airborne School, and Ranger School. Second Lieutenant Dieter holds a bachelor's degree from Creighton University, Omaha, Nebraska.



Letter To The Editor

Sand Grid

"Fix the bunkers at Range 2 before cadet field training 1995!" This was a recurring After Action Review comment after cadet field training at the United States Military Academy (USMA). Range 2 is used for the fire support training committee, and the 10-year old sandbag gun emplacement bunkers had deteriorated past the point of repair; a "new look" was needed. We had time to do this right, but the question was how and have a state-of-the-art field fortification. A review of FM 5-103 (June 1985) revealed no current design for a towed 105 mm howitzer position. FM 1-15 (June 1972) has a series of sketches that depict such an emplacement from the Vietnam era. It was a starting point.

Then the December 1994 *Engineer* magazine article "Sand Grid: A Multipurpose Construction System" caught our eye. This looked like the optimal solution for a low-cost, long-life and quick fix to our problems. We called the Engineer Center for a design for the 105 mm light Howitzer emplacements using sand grid. Additionally, Alpha Battery, 1-7th FA, 10th Mountain Division,

provided a schematic of a fixed gun emplacement from their TACSOP. The USMA engineer platoon, a combat heavy platoon with both horizontal and vertical construction capabilities, reviewed a composite design sketch synthesized from the source documents. Materials were ordered and a time schedule was set. The gun emplacements needed to be complete by 30 May 1995, so summer training could start on schedule. The engineer platoon was ready to start their mission.

Construction went better than projected and the four emplacements were done well ahead of schedule. It took about 14 hours per gun emplacement with a work crew of seven soldiers, a small emplacement excavator (SEE), and two push-propelled compactors. We found that the sand grid for a 105 position, 30 pieces (8" x 11' x 5') easily fit in a 5-ton cargo truck. The nature of the sand grid also allows the emplacement to be taken apart and carried to the next location.

With the demands of military operations other than war and low intensity conflicts, this is something that every field artillery commander should include in his basic load of supplies for deployment. Sand grid would work well for base camp force-protection measures, which eat up precious man-hours and are critical in the entry and lodgement phases of operations. The sand grid worked extremely well for us and we propose that all units look seriously at incorporating this time-saving, expedient, and economical force-protection method into their "go-to-war" bag of tricks.

*Major David L. Diedrich
United States Military Academy*



Partnership in Preservation

By Cecilia E. Young

As the Department of Defense budget continues to shrink, installations must cut the cost of doing business by reducing staffs, funds, and mission-support programs. So how can installations continue to maintain these programs when money is scarce? One way is to form partnerships. The Army Partnership Program has been around for many years but is receiving a resurgence of attention as a way for installations to capitalize on existing assets. And Fort Leonard Wood is doing just that!

The installation capitalized on the benefits of partnerships on a recently completed environmental project. The challenge was to complete geo-

technical stabilization and preservation of an archaeologically significant site, known as the Miller Cave Complex, at minimal expense.

Fort Leonard Woods' primary mission is to train soldiers—mainly engineer soldiers. The U.S. Army Engineer Center develops training manuals, products, and equipment required by the engineer force, and among these are materials on environmental awareness, training, and protection. Along with the rest of the Department of Defense, Army engineers are concerned with environmental preservation and conservation. Installation commanders are charged with the moral and legal obligations to preserve and protect our nation's envi-

ronment and its natural and cultural resources. Special emphasis is placed on resources impacted by projects on military installations.

This article highlights how the many players worked in a partnership to benefit their organizations, the installation, and the environment.

The Players

Fort Leonard Wood's resident archaeologist, working with University of Illinois staff, determined that the Miller Cave Complex is a significant archaeological and historical site that should be preserved. The complex includes both Miller and Sadie's Caves and a group of

Characteristic	Classification
Soil classification (Unified)	ML (sandy silt)
Soil classification (AASHTO)	A-4 (sandy loam)
Characteristic	Percentage
Natural water content (sample)	35
Liquid limit	39
Plastic limit	33
Shrinkage limit	28
Plasticity index	6
Liquidity index	37
Optimum water content	27
Swell potential	18

Figure 1. Geotechnical Test Results, Miller Cave Soils

prehistoric and historic rock carvings (petroglyphs). As both a geological wonder and an archaeological site with cultural remains dating from 6500 B.C. to A.D. 1300, Miller Cave was extensively excavated in the 1920s by the Smithsonian Institution. Subsequent digging by vandals and curious amateurs greatly reduced the site's archaeological integrity. In spite of the disturbances, recent archaeological investigations substantiated the presence of intact cultural deposits in both caves. Because of this, they are eligible for the National Register of Historic Places.

A grant was obtained from the Legacy Resource Management Program (LRMP), which was created "to promote, manage, research, conserve, and restore the priceless biological, geophysical, and historical resources which exist on public lands, facilities, or property held by the Department of Defense. The Legacy challenge is to create a program of management, conservation, and res-

toration that encourages proactive stewardship of resources at the installation level. At the same time, these efforts will be coordinated across the military services, scientific disciplines, and geographic regions."¹ LRMP granted money to perform the analysis and purchase materials, but it did not cover manpower costs to perform the work.

The scientific analysis, investigation, and design to determine the best way to preserve and protect the site were accomplished through a cooperative effort between Fort Leonard Wood, the U.S. Army

Corps of Engineers' Waterways Experiment Station, and Texas A&M University. A geological engineering professor and an engineering cadet from Texas A&M collected soil samples from three areas in Miller Cave to determine the basic geotechnical properties of the soil for the soil-cement mixture design. An undergraduate class of geotechnical engineering students at the university tested and analyzed the soil. Figure 1 shows the laboratory results.²

In addition to the standard classification tests, two soil-cement mixtures were prepared and tested. Samples containing 5 and 10 percent Portland cement by total weight (water content = 35 percent) were mixed and compacted in a Harvard miniature compaction mold. Samples were extruded and allowed to cure in a room with 100 percent humidity for 3 months before performing unconfined compression tests to mirror conditions in the field. Test results and recommendations by the Portland Cement Association (1992 and 1995) suggested the soil-cement design shown in Figure 2 for the floor of Miller Cave.²

The soil analyses indicated that in-situ (in-place) site preservation was the best

Characteristic	Recommendation
Minimum hardened thickness	4 inches
Cement percentage (weight of soil)	10 percent
Cement per square foot of cave floor	3.7 pounds
Floor coverage per bag of cement	25 square feet

Figure 2. Soil-Cement Design of Miller Cave Floor



A BNCOC student uses a rototiller to prepare the floor of Miller Cave for soil-cementing.

option for Miller Cave. The irregular cave floor, brought about by years of digging and excavation, would be preserved and hardened with the soil-cement mixture. The floor would look natural and would not interfere with educational exploration but would prevent further vandalism. Interpretive plaques would be installed to explain the historical and archaeological significance of the cave.³ In Sadie's Cave, which has been disturbed less by digging, they decided to close the entrance with an iron bar fence that allows egress to an endangered species of bats but prevents human intrusion.

With all of the historical, archaeological, and scientific research done and the plan chosen, free labor was needed to complete the project. Fort Leonard Wood's Office of Excel-

"The Miller cave project was a cooperative effort and a 'win-win' situation..."

lence, which establishes mutually beneficial partnerships for the installation, coordinated with Libby NCO Academy to make the project a field training exercise for the Basic Non-commissioned Officer Course (BNCOC). It offered students a practical hands-on experience with environmental training. Two classes from the Academy

(the 62N Heavy Equipment Construction Supervisor and the 51H Construction Foreman) also participated. Both classes were given a description of the problem and the work to be performed; they were to determine how best to accomplish the missions and develop the bill of materials.

62N Mission

The 62N students' mission at Miller Cave was to stabilize the cave floor by soil-cementing it and camouflaging the trail leading to Sadie's Cave. First, they developed plans to get all the necessary equipment and cement into the cave. The most accessible entrance is a three-foot opening located about two feet above the ground. The BNCOC students transported 75 bags of Portland cement, weighing 95 pounds each, over a rugged trail

to the cave site and into the cave. They also moved two 200-pound plate tampers, two 100-pound rototillers, and twenty-five 5-gallon containers of water to the cave. Because of the awkward size and shape of the rototillers, they were disassembled to fit through the narrow entrance into the cave and reassembled inside.

Safety was an important element of this exercise. To protect themselves from noise and dangerous exhaust fumes generated by the tampers and rototillers, the students wore hearing protection and masks while working in the cave.

Deep trenches left in the cave floor by amateur diggers required excavation with hand tools before rototillers could be used. The students applied basic information on soil-cement preparation and application described in FM 5-410, *Military Soils Engineering*. This technology is used to give dirt roads the bearing capacity needed for convoys, an engineering task in wartime. The students usually train on level surfaces like roads and runways. But the hilly, rocky terrain around Miller Cave gave them training that will be useful in mountainous areas such as Bosnia.

51H Mission

The 51H students' mission was to make the trail leading to Miller Cave safe and accessible to the public. They installed a rope handrail to guide visitors to Miller Cave and away from the trail leading to Sadie's Cave. The students also erected steps at treacherous drop-off points.

The 51H mission was not free from problems and challenges. Obstacles they overcame included setting up power generators and selecting the correct drills and bits to drill through rocks to construct the stairs.

The Winners

The Miller Cave Geotechnical Stabilization Project was a cooperative effort and a "win-win" situation for all involved.

- Fort Leonard Wood helped protect a culturally and archaeologically significant site at virtually no cost to the installation.
- BNCOC students received practical and unique hands-on training that brought U.S. history alive and allowed them to leave a legacy for future generations.
- Texas A&M students analyzed and examined soil samples from a significant historic and archaeological site.

These benefits would have been impossible without the cooperation and encouragement of installation commanders and employees. One goal of the LRMP is to form partnerships, and the Miller Cave project was a partnership in its truest sense. The LRMP is also about stewardship, and this project combined military missions with environmental stewardship. This cooperative effort sets the standards for the Army and the entire Department of Defense.

Ms. Young is the installation marketing specialist in the Office of Excellence. Previous positions include that of instructor at Rutledge College, San Antonio, Texas. At the U.S. Army Engineer School, she has been a management analyst in the Directorate of Resource Management and a training and doctrine program specialist in the Directorate of Training and Doctrine. Ms. Young holds a master of education degree from Boston University.

For more information, call Ms. Cynthia Mathews, chief of the Office of Excellence, at (573) 563-6156 or DSN 676-6156.

Project Participants:

Dr. Steven Ahler, archaeologist, University of Illinois, Urbana-Champaign; Mr. Paul Albertson, geologist, U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi; Dr. Richard Edging, archaeologist, Fort Leonard Wood, Missouri; Dr. Christopher Mathewson, engineering geologist, Texas A&M University, College Station.

Libby NCO Academy: CSM Robert Robinson, Commandant; MSG John McCalmon, BNCOC Chief; SSG Douglas Brandt, 62N Instructor; SSG David McBride, 51H Instructor.

Endnotes:

¹ *Legacy: Our Path to Enhanced Stewardship*, United States Department of Defense, Office of the Deputy Assistant Secretary of Defense for the Environment.

² "Investigation and Design of Site Protection for Miller Cave (23PU2), Sadie's Cave (23PU235), and the Miller Petroglyphs (23PU255)," Fort Leonard Wood, Missouri, prepared by Christopher C. Mathewson, PhD, PE, REG, page 18.

³ Ibid, pages 15 and 16.



ENGINEER UPDATE

Commercial numbers are (573) 563-xxxx and Defense System Network (DSN) numbers are 676-xxxx unless otherwise noted.

Director Welcomed. The Engineer School welcomed Colonel Philip Federle, the Director of Training, in January 1996. He previously served as Commander, Division Engineer Brigade, 4th Infantry Division, Fort Carson, Colorado. COL Federle may be reached at -4093.

Field Manual (FM) 5-100 Distributed. FM 5-100, *Engineer Operations*, was distributed in February. This capstone manual develops the engineer aspects of doctrine described in FM 100-5, defines the engineer role within Army operations, and provides broad principles for engineer employment throughout the theater of operations. It can be found on the Engineer School's home page on the World Wide Web: [HTTP://WOOD.ARMY.MIL](http://WOOD.ARMY.MIL). POC is MAJ Dave Brinkley, -7756.

New Family of Cranes. A program is underway to replace obsolete cranes in the engineer inventory. A 7 1/2-ton crane replaced the 3-, 5-, and 7-ton cranes in the late 1980s. Beginning in 1998, the 12 1/2-ton cranes will be replaced with Hydraulic Excavators, a commercial product that performs both as a crane and an excavator. About the same time, All-Terrain Cranes will begin to replace three cranes in the 20- to 25-ton class. The new 22-ton crane, called the ATEC, is capable of moving over a wide variety of ground surfaces. Funding to replace the old 40-ton cranes is expected in the year 2000. POC is Don Henderson, -6185.

New Itschner/Sturgis Award Regulation. Fort Leonard Wood Pamphlet (FLW Pam) 672-1 establishes responsibilities, procedures, and guidance for nominating engineer units for the Itschner Award and enlisted engineer soldiers for the Sturgis Medal. The pamphlet is scheduled for distribution in March. Once fielded, users are invited to send comments and suggested improvements on DA Form 2028 to: Commandant, U.S. Army Engineer School, ATTN: ATSE-EP, Fort Leonard Wood, MO 65473-6650. POC is MSG Michael Stephens, -4087.

M939-Series Truck Accidents. Unit leaders are urged to enforce standards for M939-series operator training, which includes operators of M929 dump trucks. Since FY91, 157 accidents involving M939-series trucks have resulted in 37 fatalities and 127 injuries. Most of the accidents resulted from skidding, loss of traction due to braking, or driving too fast for conditions. The major areas of concern are braking and rollovers. Maintenance units are replacing the trucks' auto-limiting valves with relay valves, which will improve their braking capabilities by 15 percent. A revised operator's manual, scheduled for distribution in June, states that the correct payload is 5 tons both on- and off-road. A new training video is available through local Training Support Centers. Request M939-series: *Operating at Risk*, TVT 20-1088, PIN 708408. POC is SFC Charles Olsen, (334) 255-2695.

Department of Training and Doctrine
(DOTD)

Directorate of Combat Developments
(DCD)

Engineer Personnel Proponency
Office (EPPO)

Engineer Branch Safety Office
(EBSO)

Libby NCO Academy

Live Mine Training. A recent accident involving an M21 antitank mine seriously injured two soldiers. Restrictions for live mine training are in message HQDA, DAMO-TR/DACS-ST, 141237, dated December 1990, and in DA PAM 350-38, *Standards in Weapons Training*. A summary of these restrictions follows:

- No training is allowed with live M14 mines.
- All approved mines will be armed/disarmed not more than 25 iterations per mine.
- No trip wires or booby traps will be used.
- Training with an M16 antipersonnel (AP) mine will be done with the positive safety pin remaining in the M605 fuze.
- No pre-1957 fuzes will be allowed in training with the M16 AP mine.
- Live mine training and simulator training will not take place concurrently at the same location to preclude a live mine being mistaken for an inert mine.

FM 20-32, *Mine/Countermine Operations*, provides guidance. Conduct all arming and disarming in the prone position. Units must adapt the basic risk assessment provided for each of the above mines to account for local conditions. POC is Paul Rusinko, -4025.

Army Physical Fitness Fallures (APFT) and Enrollment Criteria. Effective 1 April 1995, noncommissioned officers (NCOs) must pass the APFT and meet height/weight requirements in Army Regulation 600-9 prior to enrollment in any NCO Education System (NCOES) course. Effective 1 November 1995, these criteria also apply for entrance to the Drill Sergeant School (DSS). A total of 32 soldiers in FY95 and 13 soldiers to date in FY96 were denied enrollment to NCOES and DSS due to the APFT requirements. Soldiers who meet the "extenuating circumstances" criteria described in AR 351-1 and TRADOC Regulation 351-10 will be retested at a later date. Leaders are urged to enforce these criteria at the unit level. POC is CSM Robert Robinson (573) 596-6942.

Program of Instruction (POI) Change for the Advanced NCO Course (ANCOC). In December 1995, TRADOC approved the proposed POI change to the career management field (CMF) 12 ANCOC. Implemented in Class 1-96, the new POI adds one week to the course length and integrates tactics in the instruction. As a result, ANCOC students are integrated with Engineer Officer Basic Course (EOBC) students in the classroom and during a tactical exercise without troops. The enhanced training provides an opportunity for potential platoon leaders and platoon sergeants to work with EOBC lieutenants prior to assignment at their first units. POC is CSM Robert Robinson (573) 596-6942.



By Command Sergeant Major Roy L. Burns, Jr.
U.S. Army Engineer School

Readiness in the Army Depends on the Enlisted Force

As my tour at Fort Leonard Wood comes to an end, I can truly say that it has been a very rewarding assignment. As the Engineer Center and Regimental Command Sergeant Major, I have shared my energy and experiences with you to contribute to our readiness mission of training soldiers and taking care of families.

During the past 38 months, many changes have affected our engineer force structure. We have consolidated several military occupational specialties (MOSs) and are working some possible realignments for equipment. MOS 12B (combat engineer) was consolidated with MOS 12F (engineer tracked vehicle crewman); it is now MOS 12B (combat engineer). MOS 83E (photo and layout specialist) was consolidated with MOS 83F (printing and bindery specialist); it is now MOS 81L (lithographer). Between 1992 and 1995, our active component engineer force structure dropped from more than 40K (thousand) to 24K. Despite this drawdown, we must continue to remain trained and ready; adhere to tough, realistic standards; and strive to adapt to rapid changes.

While successfully realigning engineer MOSs, we continue to train soldiers to high standards so they will perform to the best of their abilities. Because of our continued emphasis on high standards and some innovative changes, training at Fort Leonard Wood has improved significantly. A few years ago, nobody thought that students in the Engineer Officer Basic Course (EOBC) would sit in classes with students in the Advanced NCO Course (ANCOC)—or that they would train together in field training exercises. We began integrating the first classes in January 1996, and I am confident that this program will be successful. Now NCOs will be taught tactics, which was not included in ANCOC curriculum before, and new officers will learn about NCOs' roles and how they are utilized in the decision-making process.

We have also begun to replace outdated equipment with state-of-the-art equipment to help expand our technical and tactical skills. Soldiers are now testing the M113 stretch vehicle (the combat engineer squad vehicle) and the digital reconnaissance system (DRS). We are testing new equipment such as the Grizzly and

Wolverine, which will replace the combat engineer vehicle and the armored vehicle-launched bridge. The Hornet, now under developmental testing, is the first in a series of smart munitions for engineers. With proper training and this new equipment, engineer soldiers will provide the Army's maneuver forces with the support needed to win the next battle.

We have also successfully implemented the Interservice Training Review Organization (ITRO). This program effectively consolidates engineer training in the Army, Air Force, Navy, and Marine Corps. The Army conducts civil engineer training, 51R/T and motor transport training, at Fort Leonard Wood. The Navy conducts the MOS 51B (carpenter) course at Gulfport, Mississippi, as well as the MOS 00B (divers) course at Panama City, Florida, and Port Hueneme, California. The Air Force conducts the MOS 51K (plumber) course at Sheppard Air Force Base, Texas. This joint effort allows engineer soldiers the opportunity to share their knowledge and expertise among the various branches of the U.S. military. Combining our skills will ultimately benefit all U.S. military forces.

These are exciting changes and more are expected in the years ahead. As I leave for my new assignment with the 130th Engineer Brigade, I challenge you to remain trained and ready to deploy at a moment's notice. The training provided to the enlisted force is the basis of readiness, and it is vital to the success of our missions. Accept this challenge and do your part to ensure that changes are implemented successfully.

I urge you to give your whole-hearted support to my successor, CSM Julius Nutter as he guides you through the next few years. CSM Nutter comes to the Engineer Center with a wealth of experience, including Commandant of the Libby NCO Academy. He most recently served as the 24th Infantry Division Engineer Brigade command sergeant major. A versatile, well rounded leader, he has considerable experience in both combat heavy and mechanized engineer brigades.

In leaving Fort Leonard Wood, I take with me the knowledge and experiences gained through your efforts, and I will continue to serve my country with pride. Essayons!



Engineer soldiers search for mines with a gas-cape-covered mine detector (to keep it dry). This photo was taken near Ligneuville, Belgium, during World War II.

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Engineer

THE PROFESSIONAL BULLETIN FOR ARMY ENGINEERS

April 1996

Terrain Visualization



ENGINEERING MASTERING TERRAIN

Force Mobility



Force
Counter mobility



Force Protection



Headquarters, Department of the Army

PB 5-96-2 Approved for public release; distribution is unlimited.



CLEAR THE WAY

By Major General Clair F. Gill
Commandant, U.S. Army Engineer School

Welcome to ENFORCE 96! One of my major goals is to enlist your help in spreading the message of engineers' relevance as masters of terrain. My motives and our challenge follow.

"Relevancy" is the direct relationship—the importance, significance, and demonstrable bearing—to a problem. Working harder or smarter at old patterns is not relevancy. Nor is it simply harnessing the power of integrated information as we do in Force XXI, although that's a new manifestation of relevancy.

The literal English translation of the French expression *fin de siècle* is "end of century." The expression implies a weariness with the closing century and a sense of optimism for the new. We live in extraordinary times as we approach both a new century and the 2,000-year mark of the common era. Recently we've witnessed the death of a military empire, and many of the grim possibilities for which we trained as young soldiers have vanished. The process of change has accelerated. So what "attitudinal adjustments" must Army engineers make to cope with accelerating change and the expectations of the approaching millennium? It seems to me that we have two choices: We can wait to see what new challenges wash upon us, or we can renew our relevancy. That's not much of a choice! Let's look critically at our collective ability as engineers to project relevancy into the new millennium.

Why is the Engineer Regiment always lapping up the dregs on resource issues? Why does something have to get broken (I mean really broken, like countermining) before we focus attention and rally resources? Apparently we have a relevancy-projection problem. It's not that we are irrelevant—we are very relevant. The problem is that we fail to articulate our value to those who do not wear the Essayons button. That large group includes the decision makers who currently allocate resources as well as those who will someday be decision makers.

The approach of a new century has raised expectations that patterns of international behavior during the bloody 20th century are dangerous and obsolete. Historian Barbara Tuchman, in her book *The Proud Tower*, described the world during the period 1890-1914. She developed the premise that weariness with warfare and the belief in progress created high expectations for the 20th century. Now, at the other end of the 20th century, similar expectations are being optimistically forecast. The thesis is something like this: The concept of war developed sometime after humans transitioned from the nomadic hunting and

gathering era to the agricultural era. Agriculture demanded that we protect not only our homes and possessions but also the land needed to grow food. The industrial revolution broke the old patterns of subsistence and now, in the postindustrial era, we are finally ending the age-old cycle of war. Some people say that war is on its way to the scrap heap of history. While they may not articulate their beliefs, many Americans believe this rationale, and our political processes (including the defense budget) are being influenced as a result.

Let's consider some specifics. The peace process in the former Yugoslavia is at center stage. Engineering capabilities in Bosnia (such as countermining and river-crossing operations) are receiving much attention. For years, Army leaders had neglected the relevancy of these capabilities although, as engineers, we knew their importance very well. This was partly because countermining operations were difficult to model and river crossings were hard to do and usually gummed up perfectly good maneuver exercises. Nevertheless, we should have articulated the relevancy of these capabilities more clearly.

Engineers must create relevancy by giving the "boss" something he or she needs and can't get anywhere else. It seems to me that we spend a lot of time convincing ourselves of our relevancy when there is a long list of powerful would-be friends who are starved for our message. For example, in peacetime, we will often demonstrate our relevancy within models and simulations. To be recognized as masters of terrain, though, we must force the integration of real and dynamic terrain and its impacts into all of our land-force models and simulations. Then every time we train, commanders will know how important engineers are to successful operations.

The relevancy of engineers depends on our ability to articulate and project our unique and enduring skills. Several factors affect this capability. The first is a recognized weakness—engineers' shortcomings with the English language. (We often speak more fluently in mathematics or physics.) Second, we tend to talk mainly among ourselves—we "preach to the choir."

One way to meet the relevancy challenge and clear the way into the new millennium is to tell our story in diverse professional journals. In addition to sending articles to *Engineer*, we should consider such publications as *Military Review*, the *Armed Forces Journal*, and the *Marine Corps Gazette*. Find your pens or word processors and tell the world about our relevance. Essayons!

Engineer

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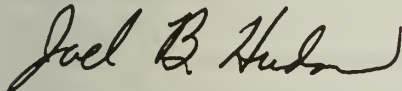
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Cover: *The Engineer Regiment's vision, shown on the front and back covers, includes four primary functions that will lead Army engineers into the 21st century.*

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Engineers: *Masters of Terrain*

By Colonel Thomas J. Hodgini and Michael L. Fowler

When United States armed forces are called upon, they will be required to quickly achieve "full-spectrum dominance" over any potential enemy. Joint Vision 2010, the vision of the Joint Chief of Staff, states that forces will have to rely on their speed and agility supported by advanced communications and information technology. According to a recent issue of *Defense News*, this vision was largely written by a former commandant of the Engineer School, Lieutenant General Daniel W. Christman.

As the Army enters the 21st century, several factors will require that the Army modify the way it conducts operations. Some of the factors driving this change are new technology, reduced resources, extended battlespace, and the move toward a CONUS-based force. The ability to project ground forces from the continental United States to anywhere in the world is the essence of deterrence for regional conflicts.

Even with these changes, the great battle captains of history would recognize old patterns of war in today's conflicts after overcoming their initial astonishment at the weapons of modern war. Those battle captains did not achieve victory solely on the basis of superior weapons. They also employed doctrine that dominated maneuver and controlled their adversaries.

The Vision

In the 21st century, engineers will master terrain to shape the battlespace. As a key member of the combined arms team, engineers will combine their skills with technologically advanced, information-based systems to give the maneuver commander the conditions he needs for decisive victory. We cannot realistically expect battle leaders to intuitively grasp the value of terrain. Instead we must provide tools and decision aids to build this capability. Terrain visualization technologies offer leaders real-time, three-dimensional capabilities to walk or fly through terrain before deployment and battle. Where the industrial revolution harnessed energy and machines to enhance muscle power, the information revolution harnesses communications, sensors, and

computers to enhance brain power. This is the power of Engineer Force XXI (ENFORCE XXI).

ENFORCE XXI is a term that describes the evolution of engineer soldiers and units into the future U.S. Army. While only the shadows of great future events can be dimly perceived in our time, the requirements for the future Army reflect some current conditions. Our current National Military Strategy requires that the Army project military power to compel any adversary to do our will, deter aggression, reassure our allies, and support at home.

ENFORCE XXI incorporates combat engineers within maneuver forces to achieve decisive victory in support of national policies. Tomorrow's operations place engineers as full partners within joint and coalition responses. As partners in information-based operations on the digitized battlefield, engineers are integrated in versatile organizations that can function in both war and stability and support operations across the full spectrum of environments. The ENFORCE XXI organization is easily tailorable, rapidly deployable, operationally agile, capable of leveraging technological advancements, organized around information, and formed with an optimum mix of both the Active and Reserve Components.

Our vision of ENFORCE XXI employs enhanced battle command, information, and technology to empower highly efficient units to accomplish much larger missions in mounted and dismounted battlespace throughout the continuum of operations. The result: increased force lethality and survivability. Leap-ahead technologies enable engineers to emplace obstacles just in time to control the enemy. Areas filled with intelligent munitions allow free passage by friendly forces and coordinated attack on the enemy. Ground robotics systems take the soldier out of harm's way in especially dangerous situations. Engineers predict requirements and base responses on simulated dynamics in a virtual world. Robotics construction equipment, cruise-controlled operating aids, global positioning systems, and range-of-sensor controls bring precision, speed, and nonstop operations to construction. Engineer headquarters mass efforts precisely, monitor execution, and make changes on the move. These engineer operations are key to the success of "full-spectrum dominance."



Mastering Terrain

The engineer mission to master terrain is conducted at all levels of an operation—from task force to theater to strategic levels of CONUS locations—and is dispersed over all of the extended battlefield. Mastering terrain includes four primary functions:

- Force mobility
- Force countermobility
- Terrain visualization
- Force protection

These functions (shown on the front cover) allow the commander to fight where he wills; go where he wills; use the terrain as a weapon; portray the terrain; and mount, sustain, and recover from operations by creating and maintaining an array of lines of communications (LOC). (In Force XXI, the LOC may be a mixture of combat trails, main supply routes, and strategic forced-entry locations.) The four functions also encompass engineer support in defensive areas and combat service support areas as well as the requirement for engineers to fight as infantry when necessary. Detailed descriptions follow.

Force Mobility. The engineer force modifies, overcomes, and uses terrain so the commander can fight where he feels is best for a quick, decisive victory while eliminating as many casualties as possible. This engineer support allows the maneuver commander to focus on tactical operations and frees him from terrain constraints. Force XXI units will rely on mobility to quickly overcome the enemy. Keeping his maneuver forces mobile is a key concern for the commander, and his ability to decide where and when to move should be unrestricted. The engineer force ensures this capability by building and maintaining an entry base in any environment; by finding, fixing, and building routes through any

terrain; by eliminating obstacles that might impede maneuverability; and by breaking into defensive structures.

Force Countermobility. Using the terrain as a weapon against the enemy enhances the commander's ability to mass fires for an overwhelming decision. By employing obstacles before and during battle and by disguising terrain reality, engineers cause frustration and confusion for the enemy. These activities disrupt enemy operations and momentum and provide a window of opportunity for our combat forces to initiate their attack.

Terrain Visualization. By portraying the terrain as digital images and information, engineers enable the maneuver force to produce a precision engagement. Engineers provide the allied forces' battle command staff with a relevant picture of the battlefield and the detailed terrain data they need to maneuver and make decisions. Providing a terrain picture, detailed analyses on the terrain, and updating video-mapped images in real time are engineer missions that give our forces the information they need to operate in a digitized war. The terrain pictures and analysis tools engineers provide are the underpinnings to all applied information used to depict the battlefield.

Terrain visualization has already added to the success of the Army's Advanced Warfighting Experiments (AWEs). Through the Joint Venture axis of Force XXI, AWEs have provided—

- Opportunities to experiment with concepts and emerging systems.
- Methodology to evaluate results.
- Means to modify systems to meet identified requirements.
- Insights leading to optimizing military capabilities.

Additional information about the AWEs is provided in an article beginning on page 5.





Force Protection. Managing terrain, upgrading terrain, and constructing on terrain yield the capability to reinforce, support, maintain, supply, and reconstitute the force. Modern combat systems and new technologies (such as information-based construction techniques and light-weight, high-strength construction materials) enable engineers to provide more responsive and complete force protection. Throughout all phases of operations, engineers construct and augment initial defenses with fortifications and protective structures; hide the force through wide-area camouflage; and decoy enemy fires, harden critical facilities, and install sensor systems for facility protection. This function provides full-dimensional protection for the force, not only from enemy fire but also from weather, nature, and physical limitations.

In Force XXI, the force-protection function is expanded in at least three areas.

- **Defensive Positions.** At different times during an engagement, forces require defensive positions when massing fires. These positions are required for soldiers, armored/mechanized vehicles, artillery, aircraft, and other support equipment. Engineer soldiers provide the expertise and equipment needed to adequately protect the force in areas where they may be subject to enemy fire. In addition to building positions, engineers use camouflage and concealment to increase the survivability of allied forces.
- **Force Beddown.** As forces continue to operate, they require areas to regenerate from the fatigue of military missions. Engineers provide the technical expertise to plan, construct, manage, and contract, as required, adequate areas to house, rest, and care for soldiers.



- **Lines of Communication (LOC).** Engineer support to the force allows focused logistics by creating and maintaining combat trails and LOC. For the maneuver force to maintain a high level of mobility, their lifeline for supplies must be kept open. Without adequate LOC and routes, combat service support units are unable to deliver the assets needed to keep the force moving and fighting. Engineers design, create, and maintain the LOC in all areas so that traffic can move throughout the battlespace.

In summary, the 21st century engineer leader will continue to be a critical link to the maneuver commander. The leader of Force XXI will control semi-autonomous units over an expanded battlespace. He will use tools such as the Countermobility Remote-Control Computer, the Obstacle Planning System, and the Route Planning and Assessment System. With a solid base in engineer, combined-arms, and joint doctrine, the engineer leader will combine leadership skills, a deep understanding of the terrain, second-nature computer literacy, and overall versatility to provide situationally responsive support.

The Road Ahead

As the Army moves toward a fully digitized force, Army leaders must realize that information alone will not defeat enemies or win wars. Much of the physics of war remains constant. A cubic yard of dirt will require the same amount of energy to move tomorrow as it did in World War II. Mastering terrain is key. Throughout the 21st century, engineers will continue to multiply lethality and dominance for the total force by leveraging terrain. Our 2010 mission of mastering terrain, along with its accompanying four battlefield functions, facilitate our efforts to reach a common vision for the regiment:

"The Engineer Regiment...trained and ready, a rapidly deployable and versatile member of the strategic force...combining efficiencies of information with physical and technical capabilities, to master terrain in support of decisive victory."

The nation will continue to achieve decisive victory, particularly when the full power of our regiment is unleashed to enable power projection, enhance infrastructure, and exploit terrain. Together, all members of the regiment, from the combat engineer soldier through our engineer commands to the USACE Corps Real Estate Support Teams (CREST) and contractors, form the greatest capability to achieve this vision that the world can produce. 

Colonel Hodgini is Director, Department of Training and Doctrine, U.S. Army Engineer School. He previously served as Deputy Director of Combat Developments for Force XXI Integration at the Engineer School.

Michael Fowler is a military engineering development analyst in the Concepts Division, Directorate of Combat Developments, U.S. Army Engineer School.

Force XXI Engineer Update

By Colonel Edwin Arnold and Vern Lowrey

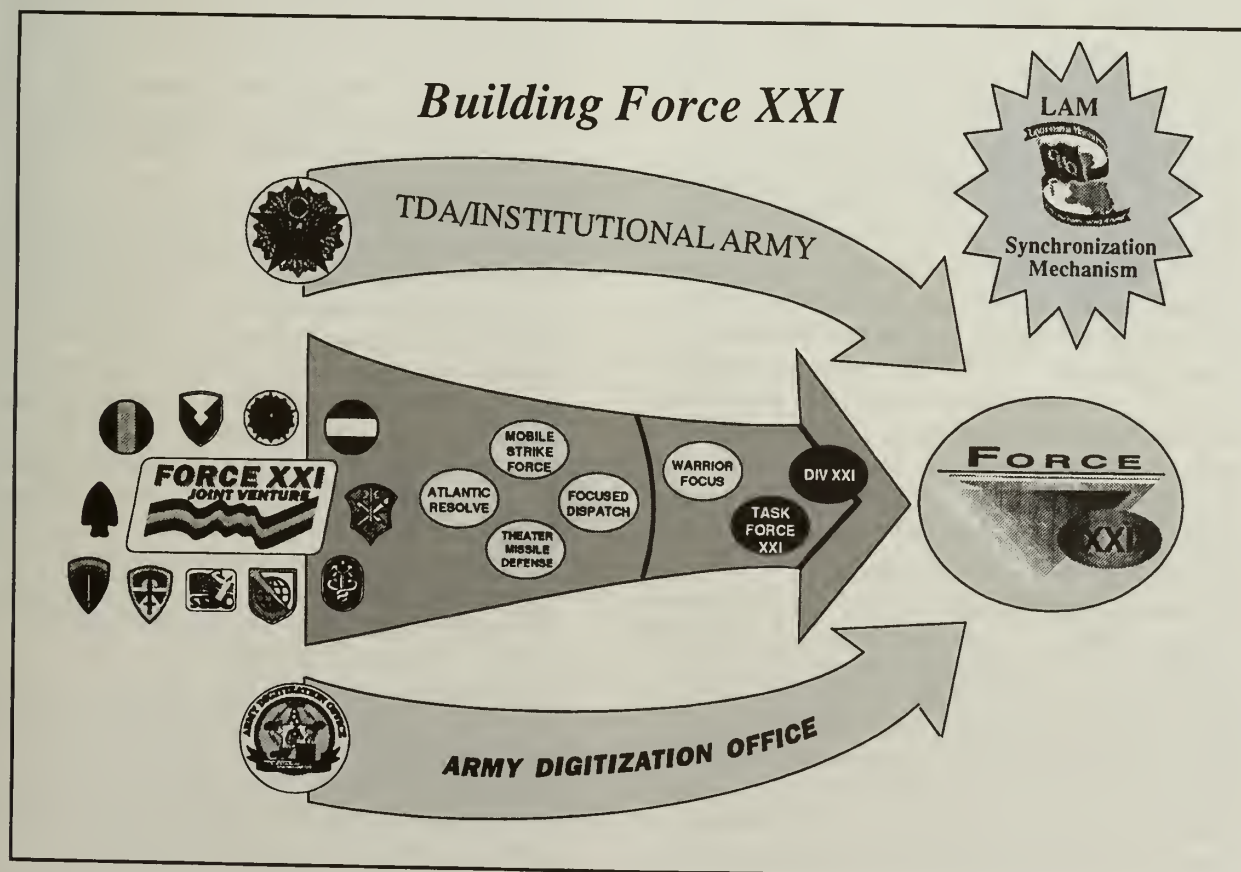
The April 1995 edition of *ENGINEER* described how the Army and the Engineer School were "Shaping Force XXI Engineers." This article relates where we have been since then and provides lessons learned and a view of what is ahead. The Engineer School continues to support the Army's Force XXI Campaign Plan to move the Army into the 21st century. A central theme in that campaign is to exploit information-age technologies to win the information war primarily through the use of digitization.

Joint Venture Battle Lab Experiments

As part of the Force XXI Campaign Plan, TRADOC continues to lead the main effort, called *Joint Venture*, by using Battle Lab experi-

ments to test and showcase information-age technologies. Battle Lab experiments are iterative and progressive in nature and focus on a specific capability or technology opportunity. Each experiment may employ combinations of live, virtual, and constructive simulations.

- **Live simulations** are exercises conducted by soldiers and units in a field environment, preferably against a tactically competitive opposing force.
- **Virtual simulations** employ man-in-the-loop simulators, reconfigurable simulators, and/or distributive interactive simulations that duplicate effects of the terrain, the weather, and the enemy situation.
- **Constructive simulations** portray soldiers and equipment reacting with generated message traffic to simulate operational conditions.





Assault Breach Marking System (ABMS) mounted on an M1 tank

Advanced Warfighting Experiments (AWEs). Large-scope Battle Lab experiments include AWEs. They are center-of-gravity culminating efforts focused on a major increase in warfighting capability. AWEs provide insight into critical decisions affecting future Army and engineer doctrine, training, leader development, organization, materiel, and soldier (DTLOMS) programs. Sponsored by TRADOC Battle Labs, AWEs cross many, if not all, of the enduring battlefield functions and battlefield dynamics. Several recently conducted Joint Venture Campaign AWEs provided engineer-related insights:

- **Prairie Warrior/Mobile Strike Force (MSF)** 95 was a constructive simulation at Fort Leavenworth, Kansas, with selected Command and General Staff Course students. Conducted from February through May 1995, the experiment focused on MSF battle-staff improvements due to digital technologies. Several engineer-related systems were employed successfully—Deep-Attack Wide-Area Munitions (DA-WAM), the Airborne Standoff Mine-Detection System (A-STAMIDS), and the Terrain Evaluation Module/Obstacle Planning System (TEM/OPS). Organizationally, using a separate engineer command headquarters at echelons above corps proved essential. The experiment showed that we need to explore ways to make the Deployable Universal Combat Earthmover (DEUCE) transportable by helicopter to support light force survivability.

- **Focused Dispatch** was a virtual and live simulation conducted in three phases at Fort Knox and the Greenville Training Area, Kentucky, during the summer of 1995. It used a digitized heavy battalion task force in both virtual and live experiments. The Hornet (a hand-emplaced wide-area munition) proved successful at shaping the battlespace in the live experiment. In the virtual experiment, Hornets were made visible by using

an intelligent minefield (IMF) emulator. It has the ability to turn the Hornet sensors on or off, and it can launch submunitions against threat armored vehicles. Results from the virtual engagements were manually passed to the live simulation to depict actual battlefield effects. During the live experiment, the Assault Breach Marking System (ABMS) successfully marked breached lanes while sappers re-mained under protection in their squad vehicle. A robotic countermine vehicle (ROC-V) was used to a limited extent to breach complex obstacles. A TEM/OPS workstation provided tactical decision aids at the maneuver brigade level. The battalion task force engineer (engineer company XO) occupied a workstation in one of two digitized task force command and control vehicles. Insights from Focused Dispatch AWE will be used to enhance the Task Force XXI AWE at the National Training Center in February 1997.

- **Warrior Focus** was a live simulation conducted in two phases at Fort Drum, New York, and at the Joint Readiness Training Center, Fort Polk, Louisiana, during the summer and fall of 1995. This AWE employed a light/heavy battalion task force to demonstrate increases in force lethality, survivability, and tempo gained through digitized and own-the-night (OTN) technologies. The Thermal Mine Avoidance System (TMAS) performed well in the AWE and has subsequently received support from Army leaders. MG Hendrix, Commandant of the Infantry Center, recommended that the Army procure the TMAS for the field. Efforts are ongoing to make the TMAS available for countermine efforts in Bosnia. The Antipersonnel Obstacle Breaching System (APOBS), a modern replacement for the World War II vintage bangalore torpedo, was used extensively at Fort Drum and at Fort Polk. As with TMAS, it performed as winning technology. A Multispectral Imagery Processor (MSIP) provided tactical decision aids to the task

force and higher brigade headquarters at Fort Polk, although an early attempt to demonstrate split-based operations was unsuccessful. Engineer platoons were equipped with OTN technology that aided in breaching and countermobility operations. On the down side, an attempt to send obstacle-intent graphics overloaded the digital connectivity system, demonstrating the need to further develop digital systems.

Other Battle Lab Experiments. TRADOC also conducts Battle Lab experiments that are smaller in scope than the AWEs. They include Battle Lab Warfighting Experiments (BLWE), Advanced Concepts and Technology II (ACT II), and Concept Evaluation Program (CEP) experiments.

- **Battle Lab Warfighting Experiments.** The Engineer School supports ongoing BLWEs, such as the Dismounted Countermine BLWE being conducted by the Dismounted Battlespace Battle Lab at Fort Benning, Georgia. BLWEs apply to a single battlefield dynamic and may be a single event or progressive, iterative simulations.
- **Advanced Concepts and Technology II.** The Engineer School has limited participation in the ACT II program, which provides funding and an architecture that facilitates industry interaction with the TRADOC Battle Labs. The intent of ACT II is to invite industry to propose mature technologies, nondevelopmental items, and/or prototypes for demonstration as Battle Lab experiments.
- **Concept Evaluation Program.** This innovative testing program provides a quick reaction and simplified process to resolve DTLOMS issues. CEP provides the Battle Labs and the Engineer School the ability to acquire, lease, or fabricate equipment and conduct experiments and tests to determine military utility or the potential to satisfy DTLOMS needs. CEP experiments are used to assess new operational concepts, such as one recently conducted for the multirole bridge company concept. They are also used extensively in the proof-of-principle and development/production prove-out phases of the materiel acquisition process. For example, the CEP was used for developing the new hydraulic excavator (HYEX).

Battle Lab Experiment Engineer Trends

The AWEs conducted in 1995 identified common issues currently being worked by the Engineer School, other Army agencies, and supporting civilian contractors:



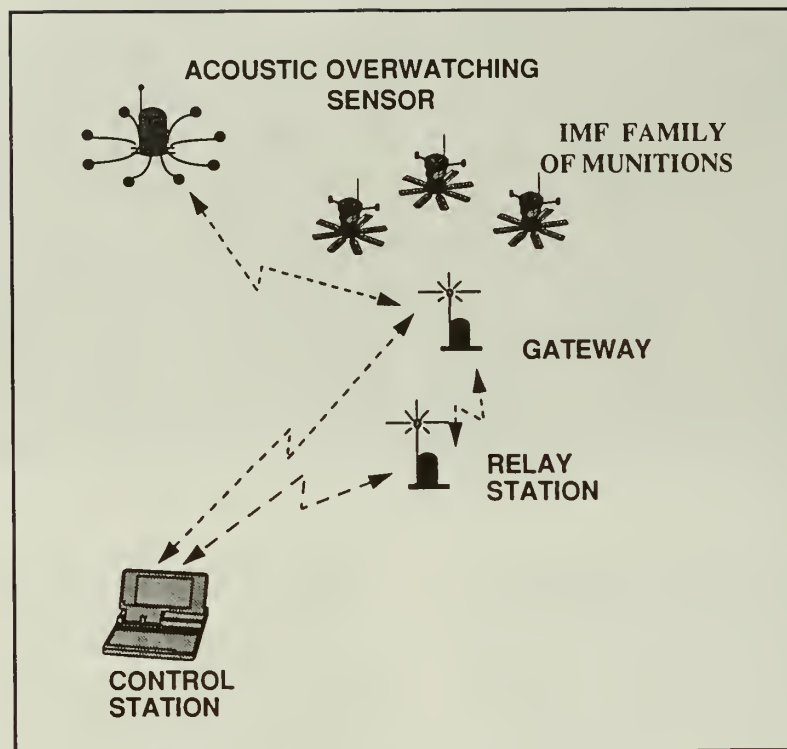
Antipersonnel Obstacle Breaching System (APOBS) components

- Provide Army Battle Command System (ABCS) components with the same common digital terrain picture for full situational awareness and battlefield visualization by the commander.
- Equip and train engineers with the same digital and OTN technologies used by the forces they support.
- Insert engineer planning software tools into ABCS components.
- Refine the employment concepts of Hornets and IMFs based on AWE results.
- Recommend that the Army invest now in the ABMS, the TMAS, and the APOBS programs and get these systems to soldiers in the field.

Future Experiments

Several more Joint Venture AWEs are planned through 1997. The Engineer School is working to ensure that vital engineer issues and initiatives are inserted, executed, and analyzed in future Joint Venture AWEs. This will result in engineers being properly organized, trained, and equipped in a newly designed heavy division structure beginning in 1999.

Prairie Warrior 96 AWE. The Battle Command Battle Lab will conduct this experiment at Fort Leavenworth, Kansas, and Fort Hood, Texas, 6-14 May 1996. Command and General Staff College students will participate in a constructive simulation of an Army corps and several divisions and a digitized MSF fighting on the mythical island of Lantica. Engineer-related exercise initiatives include the MSF mobility/survivability brigade headquarters, terrain visualization using TEM/OPS, IMFs, river crossings, theater engineering, and light infantry engineer support.



Intelligent Minefield Configuration

Task Force XXI AWE. In February 1997, the experimental force (EXFOR) will conduct this AWE as a live simulation with a fully digitized maneuver brigade at the National Training Center, Fort Irwin, California. Several engineer initiatives within the Task Force XXI AWE include the Hornet, the ABMS, the Digital Topographic Support System (DTSS)/Quick-Response Multicolor Printer (QRMP), surrogate breachers, and engineer force structure. Engineers within the light task force will receive digital Maneuver Control System-Phoenix (MCS-P) workstations, digital appliques for engineer equipment and vehicles, and select OTN technologies.

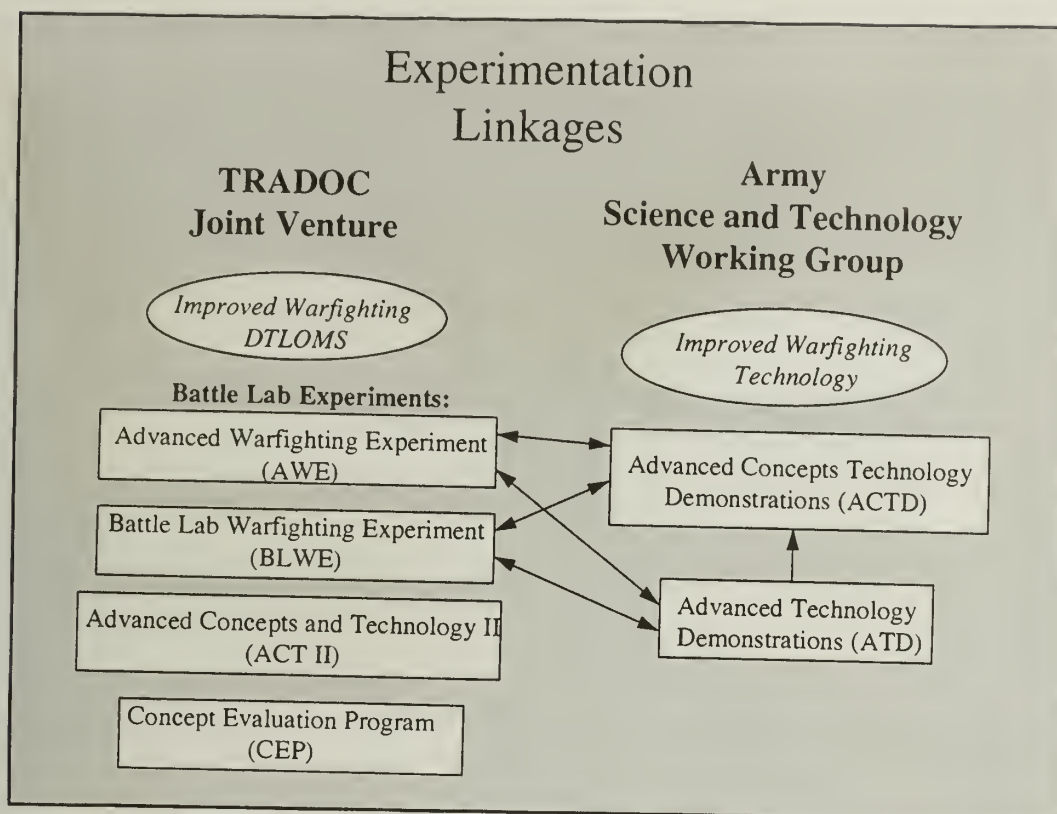
Division XXI AWE. The EXFOR will conduct this experiment in several phases at Fort Hood in 1997, using constructive simulations in an exercise similar to those performed in the Battle Command Training Program. Engineer initiatives will resemble those in the Prairie Warrior/Mobile Strike Force 96 AWE. The Army Chief of Staff will use results from this and previous AWEs to approve the final Heavy Division XXI design in January 1998.

The Engineer School is pushing the following imperatives in future live, virtual, or constructive simulations to ensure that terrain and engineer functionality and other functional areas are properly portrayed in experimental digital command and control systems:

- Modeling and simulation systems must portray realistic dynamic terrain, not featureless plains that do not impact on maneuver.
- Digital command and control systems must connect across all battlefield operating systems.
- Digital command and control systems must stress battle staff synchronization, information management, and full situational awareness across all battlefield operating systems.
- Command and control systems must ensure a common terrain database, integration, interoperability, text and graphics, and horizontal and vertical integration across all battlefield operating systems.

Science and Technology

As part of the Army's Science and Technology Program, Joint Venture AWEs and BLWEs are tied to ongoing Advanced Technology Demonstrations (ATDs) and Advanced Concepts Technology Demonstrations (ACTDs). The ultimate goal of this program is to provide the soldier with a winning edge on the battlefield. These demonstrations attempt to transition promising technological developments into tomorrow's operational capabilities. Eventually, they will evolve into systems and systems upgrades that are incorporated into the Army Modernization Plan. These demonstrations will gain importance after 1997 because the Division



XXI AWE in November 1997 is the final scheduled Joint Venture AWE. As a result, follow-on experiments will include more virtual and constructive simulations as part of ATDs and ACTDs.

Advanced Technology Demonstrations. ATDs are risk-reducing, integrated "proof-of-principle" demonstrations. The Army currently has 28 ATDs that have been approved by the Army Science and Technology Working Group. Engineer-related ATDs include—

- **The Intelligent Minefield ATD**, which will integrate new mine systems and technologies into an optimized, logistically efficient, autonomous anti-armor obstacle.
- **The Off-Route Smart Mine Clearance ATD**, which will develop technologies and concepts to neutralize advanced off-route smart mine systems and clear the way for obstacle breaching and main-support-route clearing operations.
- **The Vehicle-Mounted Mine Detector ATD**, which will evaluate and demonstrate the maturity of a vehicle-mounted mine detector that detects metallic and nonmetallic mines at tactical speeds.
- **The Rapid Terrain Visualization ATD**, which will evaluate the end-to-end battlefield visualization process from data collection through display and use by soldiers and leaders. This evaluation will ensure that terrain databases are optimized

for collection management, terrain database generation and tailoring, terrain database dissemination, and terrain data display and use.

Advanced Concepts Technology Demonstrations. ACTDs are conducted to highlight several related areas of technology and to leave residual equipment with participating units for further testing. They are an integrating effort to assemble and demonstrate a significant, new military capability, based on maturing advanced technology(ies), in a real-time operation. They are conducted at a scale adequate to clearly establish operational utility and system integration. ACTDs are jointly sponsored and implemented by the operational user and materiel developer with approval and oversight guidance from the Department of Defense. These demonstrations are the last step in determining whether the military needs and can afford the new technology. The Engineer School is actively involved with four ongoing ACTDs:

- **The Joint Countermine (JCM) ACTD** began in 1994 as a joint effort between the Navy and the Army to showcase emerging countermine technologies. Seamless countermine efforts from the littoral (sea), to beach, to inland environments will be demonstrated in two phases. In FY97, the Army will lead Phase I, which will emphasize shallow water and beach land-countermine capabilities.

Phase II, led by the Navy in FY98, will emphasize fully seamless countermining capability and clandestine reconnaissance and surveillance capabilities. Initial JCM-ACTD C4I (command, control, communications, computers, and intelligence) connectivity between the Army, the Navy, and the Marine Corps was demonstrated during the 1995 Joint Warfighting Interoperability Demonstration (JWID) from 18-29 September. Connectivity between various digital command and control systems was also demonstrated. Results from the JWID will be available in 1996.

- **The Rapid Force Projection Initiative (RFPI)** ACTD will demonstrate hunter/killer technologies for use by early-entry and light forces to reduce sensor-to-shooter communications links. RFPI employs new weapons systems such as the IMF, Enhanced Fiber-Optic Guided Missile (E-FOGM), High-Mobility Artillery Rocket System (HIMARS), and the Line-of-Site Antitank System (LOSAT). As the result of an early-version demonstration (EVD) conducted in September 1995 at Redstone Arsenal, Alabama, improvements are being developed for initial sensor-to-shooter communication links and the subsequent increases in force lethality and survivability. Currently we are coordinating efforts for upcoming ACTD activities with the 101st Airborne Division (Air Assault). Engineer systems tested during the 1995 EVD included the Hornet and the IMF. Results of the EVD identified the need to improve the IMF acoustic overwatching sensor (AOS) and to integrate engineers into the digital tactical operations center. The Engineer School is currently working the follow-on ACTD scenario and doctrinal support to the ACTD.
- **The Battlefield Visualization ACTD (BV-ACTD)** was created from the merger of two related ATDs scheduled in FY97: the Rapid Terrain Visualization ATD and the Battlespace Command and Control ATD. Battlefield visualization is the process whereby the commander develops a clear understanding of his current state in relation to the enemy and environment, envisions a desired end state, and then visualizes the sequence of activities that will move his force from the current state to the end state. The Engineer School supports BV-ACTD efforts in the areas of terrain product battle drills, terrain data updating, terrain data storage, and terrain data dissemination capability needed for Army warfighting, modeling, and simulations.
- **The Military Operations in Urban Terrain (MOUT) ACTD** will explore promising technologies that support and enhance MOUT operational concepts and transfer those technologies to the

services. Beginning in 1997, the MOUT-ACTD will attempt to expand and dominate the battlespace of the dismounted force by improving night-fighting capabilities, target acquisition, battle command, simulation, and force protection. The MOUT-ACTD engineer focus will be in the areas of urban reconnaissance, obstacle detection and breaching, terrain visualization, demolitions, nonexplosive technologies, and robotics.

The Road Ahead

The Engineer School Directorate of Battle Lab Support continues to attack down the Joint Venture axis toward Force XXI. Engineer DTLOMS programs are changing to reflect the new realities of information-age technologies. Fiscal constraints will continue to force us to make hard decisions concerning who gets modernized and who does not. Shrinking division force designs will cause organic and supporting engineer organizations to change their way of doing business.

New technologies will continue to surprise us. The demonstrated ability of our engineer soldiers to assimilate and use new technologies continues to astound many people both inside and outside of the engineer community. As we experiment with new ideas gathered from people in the field, we will continue to demonstrate the relevance of Army engineers as a critical component of Force XXI.

We consider all engineers in the field as "engineer scouts," providing eyes and ears for our efforts. Your input is needed to make intelligent and relevant decisions in the future. If we are not successful in this endeavor, engineers, like old soldiers, may never die but will gradually fade away.

Send your ideas to COL Arnold or Mr. Lowrey at (DSN) 676-4082 or (C) 573-563-4082 or send an email message to (arnolde@wood-vines.army.mil, lowreyv@wood-vines.army.mil).

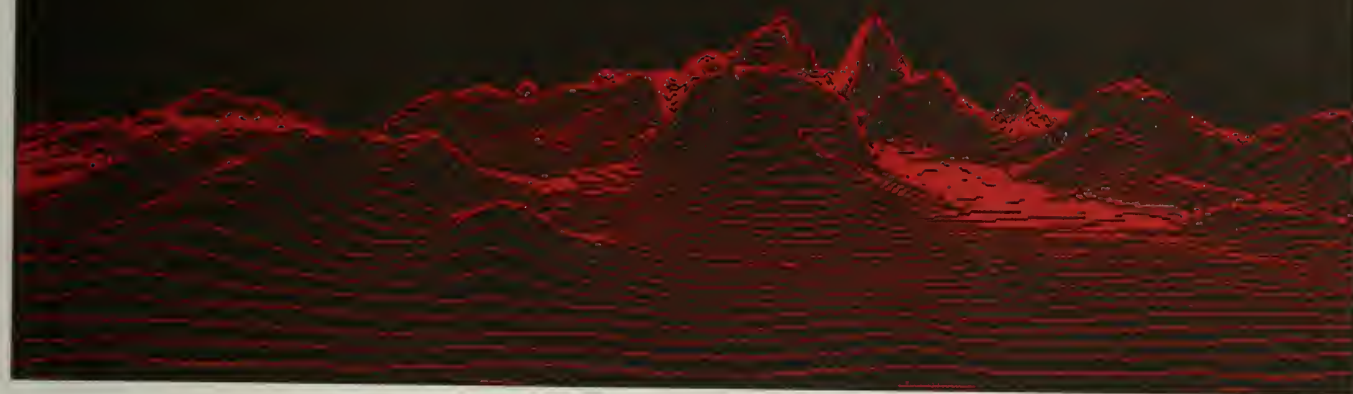


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The following information is based on a speech given by Major General Clair F. Gill at the Consolidated Army Topographic, Terrain Analysis, and Multispectral Imagery Conference at Fort Belvoir, Virginia, in November 1995.

Terrain Visualization: *The Challenge for the Whole Team*



Among the many challenges we face in today's Army, the most important one is sustaining the ability to decisively win our nation's wars. In the current resource climate, that means we must work hard to ensure that our programs are relevant and battle-focused. This is especially true for many of our Force XXI initiatives. The Army topographic community must share ideas and exchange information to build the team that will provide affordable, battle-focused solutions for terrain visualization and, ultimately, for the battlefield visualization it supports.

Unfortunately, both terms—battlefield visualization and terrain visualization—mean different things to different people. There are many participants, each in charge of some portion of this business. For example, Army Regulations 115-11 and 10-5 name the Chief of Engineers the “Topographer of the Army.” The same regu-

lations designate the Deputy Chief of Staff for Intelligence as the central Army staff proponent for Army topography and the central point of contact for Army topographic plans, programs, and requirements. The commander of the Engineer Center serves as the TRADOC commander's proponent for topographic doctrine, concepts, and training requirements.

The following is my perspective of the role that combat engineers have in terrain visualization. It identifies where we will need help from other key members of the topographic support team to collectively provide the best possible support to our ground force commanders.

Leader Development

Within TRADOC, a concept called DTLOMS (doctrine, training, leader development, organizations, materiel, and soldiers) is used to

develop solutions to warfighting requirements. All too often, the focus of DTLOMS has become materiel, with the remainder of the solution getting far less attention. This is especially so for many Force XXI terrain issues, given the growth rate of information technology. Topo battalions know all too well the challenges of receiving equipment without the whole supporting DTLOMS.

While technology is essential to our ability to provide topographic support, it may not be our greatest challenge as we focus on the true essence of terrain visualization. From the combat engineer's perspective, our greatest challenge will be leader development. Let's consider a few historical examples.

On the eve of the Battle of Austerlitz, Napoleon walked the battlefield and decided how he would use terrain to his advantage. He even had his engineers shape the terrain by digging some

By Major General Clair F. Gill



Leader training includes visualizing the terrain with the help of computers such as the Digital Topographic Support System/Multispectral Image Processor.

ditches and moving some berms. Though outnumbered, the French Army literally routed the Russian Army the next day. Much of the battle unfolded just as Napoleon had envisioned.

About 50 years later at the Battle of Gettysburg, Major General Meade, the Union commander, sent Brigadier General Warren to assess the importance of an area that Meade considered key terrain. Warren, an engineer, went to a point on the battlefield where he could see the ground and assess its impact. He confirmed the need to get forces to a hill called Little Round Top to protect the flank of the Union Army and deny that key terrain to the Confederates.

A third example involves a heavily outnumbered armor force desperately defending the Golan Heights in the 1973 Yom Kippur War. A few Israeli tanks defended the Golan heights and effectively

bought time for reinforcements to arrive. One of the keys to Israeli success at the tactical level was that often a few Israeli tanks arrived at key terrain 30 minutes before the Syrians.

These examples show a common thread. In all three cases, a warfighter visualized the impact that terrain would have on the outcome of his fight. Each saw the potential in a situation. Each understood that impact in terms of the warfighting tools with which both he and his enemy had to work. And each acted quickly enough to influence the outcome of the fight. In today's combat training centers, we revalidate these lessons over and over again—that to visualize and understand terrain is the first step toward dominating the battlefield.

These examples clearly demonstrate that while terrain visualization is a new term, it is far from

a new concept. If we keep this perspective, then leader development, not materiel, becomes our central focus for terrain visualization. To develop leaders who understand the art of war, given the tools and environment at their disposal, we must have leaders who understand terrain in the first place. The topographer must provide effective support to help that warfighter become familiar with a piece of ground before he walks on it.

Whether looking at a computer screen or actually standing on the ground, terrain visualization occurs only when you realize how you will use that terrain to accomplish the mission. If you don't understand what you see, or if you don't know how to use your warfighting tools to defeat the enemy in that environment, you won't accomplish terrain visualization, and you may not accomplish your mission.

Combat Engineer Role

As combat engineers, we have an especially important role in terrain visualization because of our mission. Terrain is a source of friction in war, and engineers—whether supporting mobility, countermobility, survivability, or sustainment—are either the lubricant or the sand in that friction. To be an engineer requires a basic, fundamental understanding of terrain because we are the ones who will shape the battlefield. And we support every other battlefield operating system when we do this.

So how will we grow leaders to truly visualize the impact of terrain on mission accomplishment across the enduring battlefield functions? And, given such mastery, how will we harness our materiel solutions to maximize our leaders' ability to exploit the terrain when they cannot walk the terrain ahead of time? Here lies the real challenge. We bombard our leaders with more and more information, but we don't necessarily succeed in giving them better information.

Consider the three-dimensional "fly through" that almost anyone can demonstrate on today's computers. Is this a good terrain visualization tool? In Vietnam, commanders were provided a similar view of the battlefield by flying them around in helicopters at various altitudes. Commanders didn't always understand what they saw from above the battlefield, but that doesn't mean we shouldn't view the terrain from that perspective. It simply means that we need to develop both the view and the leader simultaneously. We must ensure that the leader understands what he sees and knows the limitations of his view and how to use that information to win. In other words, com-

"Our engineers must be terrain visualization experts so they can help the maneuver commander use the terrain to his advantage to win."

puter models are only as good as a warfighter's ability to apply them to win. Pretty pictures don't always equate to terrain or battlefield visualization.

We recently eliminated the topographic engineer specialty and proclaimed that every engineer would be a topographic engineer. The focus of that change should be that every engineer must become a terrain visualization expert—but not necessarily a technical expert on how to use new technology to provide more terrain information. While we cannot escape the fact that our terrain visualization experts must master the information tools at their disposal, we cannot afford to make that mastery the object of our leader development. We need to focus a level above—on combined arms warfighting operations.

We need technical experts, but even more we need leaders who know how to view terrain and apply what they see to win battles. These same leaders must then articulate what the battle commander needs to know to understand terrain. The tempo of Force XXI operations will make such mastery extremely important. We must have leaders who can decide and act more quickly than ever, and those leaders will

need battle-focused decision aids if they hope to have any chance of coping with the operations tempo of 21st century warfare.

Engineer Center Role

As the Army topographic community continues to make impressive strides in providing greater resolution of the terrain to warfighters, the Engineer Center will provide a parallel effort to identify and develop the leader skills necessary to use that information effectively. Some of our effort will, in turn, drive the requirements for materiel solutions. The focus will be on developing solutions to meet battle-command requirements, not the other way around.

In practical terms, our engineers must be terrain visualization experts so they can help the maneuver commander use the terrain to his advantage to win. We must keep that perspective as we develop our terrain visualization support to battlefield visualization.

Our early experience with advanced warfighting experiments and the experimental force indicates that leaders and their soldiers in the field are getting overwhelmed with so-called "good ideas" that lack focus. They are drowning in new technology, new media, new jargon, and massive amounts of information of all types. In that type of environment, we must help warfighters sort the wheat from the chafe.

Army topographers can make a good start to this end by doing two things: learn to speak the warfighter's language and avoid bombarding him with highly technical language, endless "topospeak," and unique acronyms. Then we must become experts on our doctrine for tactical decision making

and the staff processes that support it. With that expertise, we will acquire the ability to provide battle-focused information about terrain and not simply offer a smorgasbord of computer graphics and data that result in information overload.

Modeling and Simulation

Another area where the Army needs our help is in modeling and simulations, which are rapidly becoming critical to the Army's future. We will use these systems as both combat and training development tools to develop and evaluate doctrine, to train all echelons of the force, and for mission planning and rehearsal.

The requirements for dynamic terrain modeling and the consistent portrayal of terrain and its impacts present major challenges. Both require detailed terrain data and well-developed, empirically sound models. We cannot afford to develop a system or capability on a simulation and then find that the system does not work because the simulation was fundamentally flawed through its terrain database. Nor can we afford to develop tactical decision aids or mission planning and rehearsal systems that provide results that are inconsistent with reality.

If the modeling and simulation community doesn't capture the terrain's very real impact on operations when they develop our simulations, the risks are great. That is why TRADOC tasked the Engineer School to solve several key modeling and simulation terrain problems. We will examine the way we develop and manage terrain requirements for modeling and simulations. At the same

time, we will formulate a means for validating terrain models so that we get reliable, consistent results across the full range of applications. We will call on members of the topographic support team to help us with this important task. As we succeed, we will improve the terrain piece of modeling and simulations. We will also put in place the means for reinforcing future leaders' appreciation of terrain's real impact on operations every time they use one of these systems.

The Players

As noted earlier, the combat engineer is just one player in a large talented cast. We cannot succeed in the business of terrain visualization without a great deal of support from each team member. Fortunately, our team is abundantly resourced with the talent and spirit to make terrain visualization a reality.

The Defense Mapping Agency (DMA). Since 1972, DMA has provided our Commanders in Chief around the world with mapping, charting, and geodesy support. When DMA was formed from the mapping elements of all the services, we were a Cold-War, paper-map-oriented force. Technology, weapons systems requirements, and our national strategic focus have certainly evolved since then, and DMA is working hard to refocus to the new realities. As the TRADOC proponent for terrain visualization, the Engineer School is vitally interested in evolving joint doctrine for which DMA has the lead. We must figure out key doctrinal issues including—

- The need for a global geographic information database.
- The requirement for global

coverage of minimum essential terrain information.

- The need for a rapid, terrain-data-generation support capability for contingencies.
- How to exploit the strengths of both DMA at the national level and the topographic elements at the theater level to sustain battlefield visualization terrain databases.

We have long had a productive partnership with DMA's Defense Mapping School. DMA will provide much of the expertise to make our training evolve with the rest of our DTLOMS. We must continue this worthwhile partnership to ensure that our topographic support soldiers are fully versed in the new technologies and support concepts. We want them to be just as credible and effective as their predecessors have been on division and corps terrain teams throughout the Army.

We also must work together to produce a leader-development training package that will help our leaders and soldiers come to grips with the essentials of datum shifts, global positioning system strengths and limitations (to include accuracy), and the strengths and weaknesses of the digital systems we put in place. The Engineer School will take that package, translate it into basic warfighting terms, and then export it to every other school in TRADOC.

Corps of Engineers. We are fortunate to have the backing of an enormous pool of talent in the Corps of Engineers laboratories. These topographic support experts have consistently produced outstanding materiel and software solutions to meet both current and future operational requirements. As we pursue our terrain visualization objectives, we will need the backing of these

experts more than ever. They will furnish the materiel piece of our DTLOMS so that we can provide combat engineers with needed digital reconnaissance tools and our terrain teams with the capability to build and sustain terrain databases in the theater. We also need their help in solving the many challenges of database management and communications necessary to provide a common, up-to-date picture of the battlespace, both vertically and horizontally, throughout the theater.

Topographic Units. Commanders continue to receive outstanding support from topographic units. They have done a superb job of tackling how they will support operations with new systems in the midst of major changes in almost every aspect of their business. We need their input when we capture battle drills; tactics, techniques and procedures; and possible fixes to doctrinal issues.

Intelligence Community. We will continue to build our partnership with the intelligence community. We want to learn as much as we can about providing digital support from the people who developed the All-Source Analysis System. We will continue to have a common interest in solving the enormous database management and communications challenges for both the terrain and intelligence databases. We will continue to work on key doctrinal issues, such as the terrain visualization aspects of deep targeting, and including terrain visualization requirements in the collection management process.

Most of all, we must continue to work together to ensure that the warfighter knows the strengths and limitations of our

terrain information collection systems. We need special emphasis on what can be done with a map or image and how the addition of an underlying digital terrain database affects terrain and battlefield visualization. We must accomplish this with full understanding of the immense pressure that fog, friction, fatigue, and operations tempo have on the commander in the course of operations. Our success in the area of mission planning and rehearsal systems will depend on this fundamental understanding.

The Warfighter. There are many others on the team, but one member has a greater vote than all of the rest. As we continue to provide information technology to support battlefield visualization, we need the warfighters' input. In short, he must tell us what works and what doesn't, and we need to listen.

The warfighter also must demand that his terrain expert, the combat engineer, fully support the terrain-related portions of tactical decision making. That support includes—

- Identifying priority areas for terrain information collection and terrain team work effort.
- Working closely with the intelligence staff to collect key information.
- Providing a solid analysis of the terrain impact on the courses of action.
- Conducting a risk assessment when lack of terrain information results in uncertainty about what the real impact of terrain may be.

The Engineer School will continue to work closely with the Battle Command Battle Lab and the battlefield visualization crew at the Combined Arms Center to

ensure that engineers are fully integrated into the staff estimate process and that our DTLOMS are indeed battle-focused.

Closing

I think I have found the combat engineer's niche in the topographic arena. It rests on fundamentals. The combat engineer's business is terrain, pure and simple. We own the ground. Everything topographic, then, has a single purpose: to help us acquire complete ownership of that ground before we get there. That is the reason why every engineer must be a terrain-visualization expert.

If we don't apply our knowledge about terrain to translate the battle commander's terrain visualization requirements into something tangible we can provide, then who will? This is the measure of relevancy I have been speaking about.

The Engineer Center will continue to focus its topographic support on the sharp end—the battle commander's requirements. And we will focus our DTLOMS to that end as well. In so doing, we hope to give the rest of the Army's topographic team the right focus against which they can apply their considerable talents. Together we will achieve our terrain-visualization objectives.



Major General Gill is the Commander of the U.S. Army Engineer Center and Fort Leonard Wood and the Commandant of the U.S. Army Engineer School.

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Interservice Engineer Training: A Progress Report

By Captain Stephen A. Danner

In the spirit of doing things smarter with less, consolidation of joint service training makes a lot of sense. In the past year, our sister services have pooled their resources with the Army to conduct the majority of military construction engineer training at Fort Leonard Wood. B Company, 577th Engineer Battalion, provides this training for students in the Engineer Equipment Operators Course and the Technical Engineering Specialist Course. In addition, the company is responsible for Army-unique training of electricians, quarry specialists, and asphalt and concrete operators. The goal of this joint service initiative is to provide well-trained and well-qualified soldiers, sailors, airmen and marines to the total force.

After six months of operation, it is time for a progress report. The following is a summary of successful aspects of joint engineer training at Fort Leonard Wood and a few areas of concern.

Successes. Despite some expected growing pains associated with integrating and accommodating the needs of all four services, joint service construction engineer training is a success. Positive and productive results are visible to both trainers and students. Uniformity of training and interoperability among services are accepted as real advantages. Most skill requirements now are the same for all services except for some service-unique equipment. Interservice training encourages everyone to maintain high levels of professionalism, particularly in consolidated tasks involving multiple services.

Another benefit is the experience that personnel from each service bring to Fort Leonard Wood. These experience factors are important ingredients in revising course training materials. To ensure we make the right changes, we have formed Course Advisory Groups, with representation from the four services. These groups make policy decisions based on the requirements of all services. Within the constraints of the service-imposed command and control procedures, they improve teamwork and help ensure that the services communicate effectively.

Concerns. Our objective in joint service training is to establish a unified "purple" chain of command so that, within reason, all students are trained to the same standards. There are some concerns. Living conditions, policies for repeating courses, and supplemental training policies often differ from service to service. For example, Army students live under Initial Entry Training standards, while other services' students live in permanent party barracks and are afforded many more privileges. Differences in these policies sometimes affect graduation rates and cause morale problems. Additionally, students and instructors at Fort Leonard Wood remain under the command and control of the individual service, with duty at the joint courses during their training periods. A command relationship of operational control should exist between the four services to alleviate communication problems.

Another area of concern is the instructor rating system. As Ms. Connie Welch, Technical Director,

Department of Training and Doctrine, stated in the December 1994 issue of *Engineer*, we lack a uniform performance rating process for joint training instructors. For example, Army and Navy instructors may be rated by any service, Marine instructors must be rated by the first officer or civilian (GS-11 or higher) in his chain of command, and Air Force instructors can be rated only by Air Force supervisors. As joint service training matures, we must adopt a single rating system.

Equipment maintenance is another challenge. With the transfer of common service equipment, the density of construction engineer equipment increased from 305 to more than 500 major end items under Army control. The only item of construction engineer equipment common among all services is the Caterpillar D7G Dozer. The large density of equipment means that maintenance is critical to accomplishing our training mission. All of the Course Advisory Groups stress the importance of regular preventive maintenance and recommend that the program of instruction requirements address the maintenance tasks for each type of equipment. At all levels, service-unique equipment is especially difficult to maintain. The technical manuals for those items often are missing and are difficult to obtain. Because the Army mechanics are less familiar with service-unique equipment, the organizational readiness rates for that equipment are lower than the rates for common equipment.

On the other hand, use of different engineer equipment has some
(Continued on page 41)



The Hornet:

A Wide-Area Munition

By Major Gregory Fields

The Army recently completed development of the world's first wide-area munition (WAM). The M93 hand-emplaced WAM, popularly known as the Hornet, fulfills the Army's need for a lethal, deployable munition that will defeat armored vehicles at and beyond direct-fire ranges. The Hornet is the first in a family of Hornet derivatives that will change the way engineers fight and how we will influence the battle.

The Hornet program began in 1986 with a Department of the Army message. A required operational capability document was approved in 1990 that outlined a prioritized, three-phased WAM development plan: (1) deep-attack, (2) hand-emplaced, and (3) Volcano-emplaced. With the collapse of the Soviet Union and the rise in importance of early-entry operations, the priority was

changed to (1) hand-emplaced, (2) hand-emplaced with two-way communication and redeployability, and (3) deep-attack.

Initially, contracts were awarded to two contractors. Alliant Techsystems' WAM prototype was based on the sense and destroy armor (SADARM) artillery warhead. Textron Defense Systems' prototype was based on their U.S. Air Force extended-range antiarmor munition prototype. Textron won a 1990 competition and is now the sole contractor. They are continuing development and testing, with type classification scheduled for 3rd quarter FY96.

The Hornet is about to enter low-rate production and will be fielded at Fort Bragg beginning in July 1998.

How the Hornet Works

The Hornet is a 35-pound munition designed to detect, identify, track, engage, and defeat moving targets up to T-80 class tanks at ranges up to 100 meters. It can be armed manually or remotely by the M71 Modular Pack Mine System remote control unit.

Before emplacement, the soldier removes the Hornet's active battery from the shipping container and inserts it for circuit testing. The Hornet comes with the main reserve cell battery embedded in the munition, and it is not activated until final arming. Also before emplacement, manual or remote arming is determined, the target switch is set (to attack only heavy, tracked vehicles, or all tracked vehicles), and a self-destruct time is selected. The four

standard family of scatterable mines self-destruct times (4 hours, 48 hours, 5 days, or 15 days) are available, as well as a 30-day self-destruct time.

The soldier exits the area after emplacing and throwing the arm-enable switch and before the end of the safe separation time. For manual arming, the safe separation time is 5-6 minutes, after which time the Hornet will automatically arm. For remote arming, the safe separation time is 30-36 minutes. At the end of the safe separation time (either manual or remote), micro-detonators sever the cable holding the Hornet's eight legs in place, and the munition snaps upright. This visual cue (a Hornet with legs deployed) indicates that it is armed or at least no longer safe to approach. A remote arm command may be sent up to 60 days after the arm-enable switch is thrown.

An armed Hornet goes to power cycling "sleep" mode until the geophone seismic sensor detects a potential target, usually at ranges of up to 600 meters. This alerts the munition to start listening with its three microphones, which are also deployed at legs-down. The Hornet tracks the two loudest noise sources it hears and attacks the louder of the two when it reaches the closest point of approach to the munition.

Before the Hornet attacks, ground platform electronics go through a sophisticated analysis and decision process to ensure the submunition is properly programmed to engage the target. It determines if the target is moving left-to-right or right-to-left, is wheeled or tracked, and is heavy or light. (The Hornet does not

engage targets under 5 metric tons.) Hornets currently attack only tracked vehicles, but follow-on variants will engage heavy, wheeled vehicles as well. If the target is a tank, the Hornet determines if it is a diesel or turbine tank, and if it is a Russian-style tank with the exhaust port over the left rear deck. In each case, the hot spot that the submunition's infrared sensor sees is at a different offset from the engine deck (rear for diesel, left rear for Russian, and in the exhaust plume for a turbine).

Properly programmed, the submunition launches like a skeet at a 30-degree angle. It precesses (wobbles) as it flies out so it can scan the ground in overlapping circles. Fly-out time to the 100-meter range is about 3-4 seconds. Once over the target, the submunition fires its explosively formed penetrator warhead at the appropriate offset from the vehicle hot spot to achieve a mobility kill. The warhead can penetrate any vehicle on the rear deck and most on the turret roof.

Not a Mine

The Hornet began as a sophisticated off-route, reinforcing mine. But after study, it became clear that it was more correctly a short-range, autonomous antiarmor system—a robot with a shoulder-fired anti-tank weapon. The difference is explained below.

The original Hornet concept was to kill breaching vehicles as they led an attack through conventional or scatterable minefields. Hornets would be laid in front of these minefields to achieve this effect. The TRADOC

Analysis Command confirmed this as useful but also identified better uses.

In a march to contact or meeting engagement situation, an enemy force will use roads to maximize speed. Hornets employed in clusters of 3-6 munitions will disrupt this movement by causing casualties and throwing off timing and coordination. This tactic is called the *gauntlet*. One refinement is to switch deeper gauntlet clusters to detonate tanks only, so lighter reconnaissance vehicles will falsely report the route as clear. Once committed to the route, tanks encounter these clusters while the reconnaissance vehicles encounter attacks by later clusters. A second refinement is to use this tactic in conjunction with the layout of the road network to influence the enemy commander's route selection. This use elevates engineer operations to the direct attack of enemy planning and execution at regimental and divisional echelons.

A third use of the Hornet was determined in modeling at the U.S. Army Engineer School by examining enemy movements between his approach march and assault formations. At 5 kilometers or one terrain feature from our positions, Russian doctrine requires regiments and battalions to change from column of march to column of companies and column of platoons. In this scenario, Hornets are laid in a large "X" pattern (a kilometer on each side) to disrupt this prebattle activity as the enemy changes formations (see figure). This causes casualties and confusion at a critical timing point in the area where the regimental artillery group will set up to support the attack.

These uses of the Hornet are impossible (or logistically prohibitive) for conventional and scatterable mines. And while the Hornet can be used to install a linear obstacle, the munition's 100-meter range is as much of a liability as an asset. When one enemy vehicle breaks clear of a minefield, it might leave a 4-meter path; but when one enemy vehicle clears a WAM obstacle, it clears a much wider swath.

Characteristics

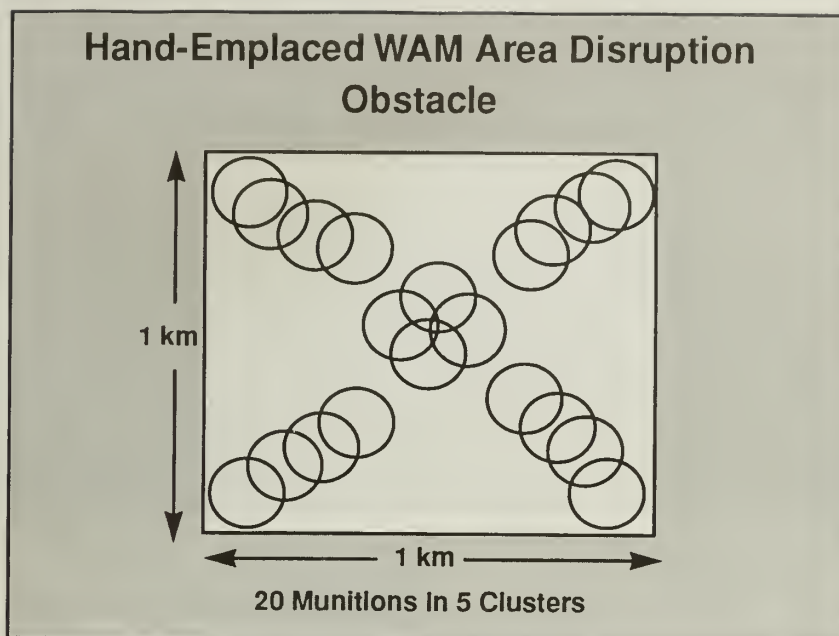
The Hornet is a first-generation, autonomous, smart antiarmor munition. Its unique capabilities allow it to be employed in a variety of missions:

Performance.

- Attacks valid targets to ranges of 100 meters, and any target approaching within 15 meters.
- Can be placed on slopes of up to 15 degrees on almost any soil and surface type.

Other Characteristics.

- Contains no explosives in the ground-platform modules. Launch is by a chemical gas generator. If disturbed, the Hornet will quick-fire and the sublet will detonate immediately on launch. In all cases, the ground-platform electronics will burn themselves out on launch to preclude intelligence use if captured.
- Can be transported by truck, ship, or aircraft. It is externally transportable by helicopter but is not yet certified for airdrop. A single C-141 aircraft can carry 1,080 Hornets.



- Is survivable in severe climatic and chemical environments and is not affected by a high-altitude electromagnetic pulse. The Hornet is certified decontaminable only before removal from its storage container.
- Can operate in all weather conditions. However, its sensors are somewhat affected by weather conditions, such as rain, snow, and very heavy fog, that weaken sound and thermal signatures.

Training and Doctrine

Beginning in 1997, the combat training centers will receive the M97 collective training device. In 1998, the M93 hand-emplaced WAM will be fielded, and the training support centers will receive the M98 individual training device. The M98s will be fielded in sets of 20 to support platoon-level training on the emplacement of multiple gauntlet clusters and single-area disruption patterns. Squads can emplace individual gauntlet clusters, but emplacing

multiple gauntlet clusters and single-area disruption patterns is a platoon mission.

Hornet emplacement will be a 12B10 common task. Institutional training for soldiers and leaders will begin in FY97. Supervisory tasks will be taught in the Basic Noncommissioned Officer Course, while leaders will learn Hornet tactics, techniques, and procedures in the Engineer Officer Basic and Advanced Courses.

The following doctrinal publications will be revised to include Hornet information: FM 20-32, *Mine/Countermine Operations*; FM 90-7, *Combined Arms Obstacle Integration*; FM 5-100, *Engineer Operations*; and FM 5-71-100, *Division Engineer Combat Operations*.

Command and control measures will parallel those required for hand-emplaced mines. Final decisions will depend on Standardized North Atlantic Treaty Organization Agreements (STANAGs) currently under discussion. The draft STANAG requires a form similar to the DA



The Hornet undergoes extensive developmental testing at Yuma Proving Ground, Arizona, to substantiate system design reliability.

Form 1355 that shows the position of each Hornet and an outline of the 100-meter lethal area(s) encompassed by them. Emplacement authority resides at Corps until delegated.

The Future

Development has begun on the product improvement program (PIP) Hornet. The PIP adds two-way communication over a single-channel, ground-to-air radio system (SINCGARS) to an Army common hardware computer control unit, with a line-of-sight range of 3-5 kilometers. The PIP Hornet can be turned off and queried to confirm its status. If the legs aren't deployed, it can be picked up and moved to a new location. If they are deployed, the Hornet reports every target it hears to the control unit. Prior to launch, it reports the type of target it is about to attack. A preplanned PIP for a repeater to extend the communication range is scheduled for 4-8 years after fielding of the PIP Hornet.

Development of the intelligent minefield (IMF) begins in 1998.

The IMF program will add an acoustic overwatch sensor, long-haul communication capability, and local computer control to the emplaced Hornets to coordinate such actions as when and what targets to engage.

An IMF can report the individual targets identified by the Hornets, approaching aircraft and personnel, and the composition and direction of enemy formations. An IMF can wait until the middle of a column to attack, and can call for reinforcing fires. It can also adjust these fires for maximum effect. Employed autonomously, the IMF can participate in counterreconnaissance, guard open flanks, or cover tactical risk areas. When emplaced deep, the IMF can cue deep strikes by artillery or air, adjust artillery fires, and report subsequent enemy presence to assess battle damage or cue follow-on strikes. Development of a dedicated deep-attack WAM variant will begin in 2000.

The Hornet is the Corps of Engineers' premier munition system. It gives maneuver commanders greater flexibility on the battlefield, allowing engineers to better support the countermobility

mission. The Hornet helps to free overtasked engineer resources for more efficient use on high-priority combat missions. In short, the Hornet provides U.S. forces with a significant advantage over opposing forces. It can support and influence direct- and indirect-fire battles as well as influence enemy decision-making, timetables, and maneuver at the regimental and divisional levels. The Hornet adds another dimension to the battlefield and expands the parameters of control and influence that affect the flow of battle.



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The Maneuver Support Center Operational Concept

By Lieutenant Colonel John Johnson and Jacqueline Guthrie

Fort Leonard Wood's leaders are paving the way for the installation to transition from the U.S. Army Engineer Center to the U.S. Army Maneuver Support Center (MANSCEN). Its birth began with Congressional approval of the 1995 Base Realignment and Closure (BRAC) Commission recommendation to close Fort McClellan, Alabama, and move the Chemical and Military Police Schools here. Fort Leonard Wood's Transition Office is facilitating the process so the new MANSCEN will be up and running by late 1999. Its structure and function concepts will mature throughout the transition process.

This new consolidated center fits into the TRADOC commander's vision of the future. General William Hartzog sees TRADOC as eventually becoming an organization of *centers* and *satellites*. A center is an organization responsible for all activities related to an enduring battlefield function such as maneuver, maneuver support, battle command and fires. Each branch of the Army is aligned with a center based on the predominate activities of the branch that relate to an

enduring battlefield function. Fort Leonard Wood's Maneuver Support Center will be one of these centers. It will be linked to numerous satellites, which are organizations that conduct functional training for centers.

The MANSCEN will include three Army branch schools—Engineer, Chemical, and Military Police—as well as Fort Leonard Wood. It will also have a consolidated Noncommissioned Officer Academy. A battle lab will be created within the organizational framework of the center. These additions will change the current Engineer Center but will benefit all who train here after the MANSCEN is activated. The primary benefit will be the battlefield synergy derived from the combined training and doctrine development of the three schools.

The operational concept of the new MANSCEN consolidates most nonteaching functions of the three schools and some of the officer and noncommissioned officer education. The commandant of each school will have supervisory control over the development of branch-specific training and warfighting doctrine, materiel, and organizations.

New Missions

The Military Police School currently trains more than 14,000 law enforcement officials annually. A joint service operation, it trains soldiers of all ranks. The Chemical School is the only one of its kind in the world. Each year, it trains more than 6,000 U.S. and foreign students, both military and civilian. The schools are similar to the Engineer School in that their personnel also develop doctrine, force structure, and material requirements for their corps. The three branches also have similar officer and noncommissioned officer courses and train their entry-level soldiers in much the same way—through one-station unit training (OSUT). All classroom training will be conducted in the school complex.

Military Police School

In addition to basic training, military police personnel receive specialized instruction in weapons, communications, and security procedures. They train in four main areas:

- Managing battlefield circulation.

BRAC 95 Opportunity

School Consolidation and Reengineering = MANSCEN

- NCOA
- Battle Lab
- Combat Development
- Training/Doctrine Development
- Leader Training
- Base Operations

Fort Leonard Wood Training Center

X
TNG
BDEs



- Providing area security.
- Processing enemy prisoners of war.
- Maintaining law and order.

Military police are responsible for battlefield circulation, which is managing the order of troops on the battlefield. They maintain area security by preventing the enemy from entering U.S. areas of operation. Military police process enemy prisoners of war by managing the confinement facilities. They maintain law and order in much the same way as their civilian counterparts.

Military police receive special-purpose training in fraud investigation, combating terrorism, hostage negotiation, and protective services. They also support the growing mission area of counter-narcotics for the Department of Defense. In that arena, they

assist many local, state, and national law enforcement organizations such as state police; the Bureau of Alcohol, Tobacco, and Firearms; and the Federal Bureau of Investigation.

Some military police training is conducted at a military operations in urban terrain (MOUT) facility. On Fort Leonard Wood, this training will take place in a 16-building complex where soldiers can practice fighting in an urban environment. MOUT training enables military police to perform their jobs with confidence in built-up areas.

The MOUT site will benefit all soldiers on post. For example, engineers often create or destroy obstacles in an urban environment. Soldiers use different techniques when fighting among buildings, and the MOUT village will provide a training site with

both intact and bombed-out structures. Soldiers will learn to take advantage of the terrain, to know where to look for snipers, and to secure their areas.

Chemical School

Chemical OSUT training includes a basic training segment; however, chemical corps soldiers continue their training by learning about—

- Smoke obscurants.
- Flame operations.
- Chemical defense.

These topics are not only an important part of training for new recruits but for the higher ranks also.

Chemical corps soldiers learn to use smoke obscurants to camouflage operations and strategic targets from enemy forces. They

create smoke screens with generators that atomize a clean, lightweight substance called fog oil, which is similar to mineral oil. Smoke helps decrease our casualties on the battlefield and lessens the effectiveness of modern enemy weapons such as optically-guided systems and certain infrared systems.

Another area of chemical corps training is flame operations, which is similar to expedient flame explosive training for engineers. In the field, existing firepower may be augmented with exploding and illuminating flame field-expedient devices such as fougasses, flame mines, flame trenches, and husch flares.

Chemical defense training for chemical corps soldiers refers to the Department of Defense requirement to train soldiers to survive on a battlefield with nuclear, biological, or chemical contamination. The training teaches them how to use protective gear and to decontaminate their equipment.

Soldiers learn chemical detection and decontamination with simulated agents and decontamination materials. Training includes lectures, films, demonstrations, and practical exercises. After they become proficient, soldiers participate in a final training exercise in a specially designed facility with stringent safety and environmental controls.

New Facilities

Although some of the missions coming with the Military Police and Chemical Schools will be accommodated with existing, excess facilities on Fort Leonard Wood, BRAC

"The primary benefit will be the battlefield synergy derived from the combined training and doctrine development of the three schools."

actions have generated a construction requirement totaling more than \$200 million. Specialized training facilities constitute the bulk of the construction, with enlisted personnel housing, general-purpose administrative space, and some range modifications making up the balance. Construction planned for the new MAN-SCEN will be discussed in more detail in a follow-up article in the next issue of *ENGINEER*.

One of the most challenging projects is the Chemical Defense Training Facility. Contractors will construct this facility under strict environmental and safety controls, and it will be operated under the same strict guidelines.

Environmental Stewardship

To protect the economic, natural, and social environments that moving the Military Police and Chemical Schools to Fort Leonard Wood could disrupt, post officials are working with a contract agency to develop an environmental impact statement. It is part of the legal requirements of the National

Environmental Policy Act (NEPA) of 1969, which federal agencies must complete when they conduct a large operation that affects the environment. NEPA is an informational tool to ensure that federal agencies consider potential environmental impacts when making decisions. It also provides communities an opportunity to participate in the planning.

To meet this requirement, Fort Leonard Wood held an open house in November 1995 to gather community opinions, suggestions, and concerns. Post officials had already developed tentative plans for training sites. However, they wanted community members to offer their proposals in case there were aspects that the post had not considered. Public comments are an integral part of the environmental statement.

The entire NEPA process and environmental impact statement preparation take from 12 to 18 months. Once this document is complete, it must be approved up through the Assistant Secretary of the Army. Then, in January 1997, contractors will break ground to begin building and modifying facilities and training areas in preparation for the new MAN-SCEN missions coming to Fort Leonard Wood.



Lieutenant Colonel Johnson is the director of the Transition Assistance Office at Fort Leonard Wood. Previous assignments include Director of Public Works and S3 and XO, 1st Engineer Brigade, Fort Leonard Wood.

Ms. Guthrie is a public affairs specialist at the U.S. Army Engineer Center's Public Affairs Office and assistant editor of ESSAY-ONS, the post newspaper.



Embracing Change: Reflections From the Chief of Engineers

By Lieutenant General Arthur E. Williams

Since I expect to retire soon—after more than 33 years in the Army—the editor of *ENGINEER* asked me to write an article that speaks directly to Army engineers, both military and civilian. “Kind of a heart-to-heart chat over a cup of coffee,” she said, to discuss issues I consider important and to pass on advice based on my Army experiences. I gladly accepted the offer, so let me give it a shot.

Pride and Enjoyment

As I reflect on what I’ve enjoyed about my career, the common thread is the satisfaction of working with great people. I’ve enjoyed their professionalism, selfless service, dedication, and caring. I’ve enjoyed watching them develop individually and as teams. I’ve enjoyed celebrating their accomplishments in producing services and executing tough missions.

I’m extremely proud of the engineer family, which includes the active and reserve components, military personnel and civilians, the U.S. Army Corps of Engineers (USACE), the U.S. Army Engineer Center and Fort Leonard Wood, engineer troop units, the public works teams, and those people working engineer actions on Army joint and combined staffs. Regardless of what part of the engineer family a person hails from, each is important to the success of the

overall mission.

If I had to leave just one piece of advice with the Army engineer family, I’d tell you to continue to be the professionals you’ve always been; continue to be dedicated to providing quality, selfless service to the nation; and take time to have some fun along the way!

Mentoring

Although I’ve never been the recipient of a formal mentoring program, there were many people whose leadership styles I watched during the years. And I learned a lot from each of them. In most cases, the people I respected were not aware that I was watching them.

One person I admired in particular was Major General Ernie Edgar, who was my battalion commander in Vietnam. As he approached retirement, I told him, “Whether you realize it or not, Ernie, you’ve been my mentor for many years.” Major General Edgar replied, “Although you didn’t realize it, I was trying to be a good mentor for you.”

I’ve also learned a great deal from our noncommissioned officer (NCO) corps. No other army comes close to having an NCO corps as strong as ours. Although I’ve had the honor of serving with many outstanding NCOs, I’d like to mention two of them. One I served with at the beginning of my career and the other in my current (and final) active duty assignment.

When I was a captain, the Army sent me straight from Germany to Vietnam. In Germany I had been a company commander, and when I joined the 87th Engineer Battalion in Vietnam, I asked to be a company commander again. My request was approved, and I was assigned to Bravo Company.

The Bravo Company first sergeant was Lindsey Bowers, and he was a model NCO. From him, I learned the importance of being technically competent, setting and maintaining high standards, and looking out for the welfare of soldiers. He retired as a command sergeant major. We’ve kept in touch, and he’s been to all my promotion ceremonies since I became a brigadier general. He also attended the change-of-command ceremony when I became Chief of Engineers.

As I close out my Army career, I’ve had the pleasure of working for almost four years with Command Sergeant Major James Skellion, the USACE Command Sergeant Major and the Sergeant Major of our Engineer Regiment. He’s another model NCO and a leader for others to emulate. Each day, Command Sergeant Major Skellion reinforced the lessons Lindsey Bowers taught me many years ago. I have the utmost admiration and respect for Command Sergeant Major Skellion. Our Army is strong today because of leaders like Command Sergeants Major Bowers and Skellion.

Advice to Leaders

I have always been grateful to those who guided me during my career, and I'd like to pass on a few lessons I've learned along the way. There are four principles that I believe are vital for leaders in the formative years of their careers.

The first is training. You must get all the training that's expected of you to do the job. If you're an officer in a troop unit, you need to seek out your strong NCOs and listen to them. As I said earlier, our Army has a superb NCO corps, and they are an invaluable learning resource for young officers.

Next, leaders need to be flexible. Don't stay in a comfort zone—try different jobs and new challenges. You also must be willing to move. Moving has always been a way of life for soldiers, and civilian advancement within the Corps is increasingly tied to being willing to move. Whatever job you are assigned, do the very best you can, and do not be overly concerned about making an honest mistake.

Third, as Lindsey Bowers taught me, leaders must set and maintain high standards. This applies not only to your subordinates but also to yourself.

Finally, leaders must take care of the people entrusted to them. Whether you're a platoon leader, a resident engineer, or a staff officer, you are responsible for the lives of people. It is your responsibility to make sure they are trained to do their job and your responsibility to look out for their welfare.

These principles apply to senior leaders as well, but I would add a few thoughts for them. Senior leaders need to recognize that change is necessary and will continue. They need to embrace change and be a champion of change where change is appropriate. I am not talking about change for the sake of change; I am talking about change that improves an organization's ability to execute its mission.

Senior leaders must have a broad perspective on what the Corps and the Army are about—particularly in these challenging times. Senior leaders need to deal with current issues, but probably their most important

task is to lead their organization into the future.

As part of their future focus, senior leaders need to prepare for their next assignment. The preparation for future assignments is not for self-serving purposes. Instead, it is based on the fundamental issue of what professional development needs to occur now to be ready to better serve the Corps and the Army in the future.

In this regard, engineers need to pursue joint assignments. Some people avoid joint assignments. I consider this a mistake because joint assignments will not go away. If anything, they'll probably increase. I can't imagine the Corps or the Army ever executing an operation that is not at least joint and probably combined.

Senior leaders also must know how to harness available and emerging technology and know how to leverage technology to increase efficiency and effectiveness. We live in a world which produces reams of instant data. Senior leaders must know what data to tap into, how to quickly sort it, and how to use that data effectively to make faster and better decisions.

Finally, a must for everyone—but especially for senior leaders—is the ability to communicate ideas both verbally and in writing. No matter how talented an individual is, the inability to effectively communicate undermines his effectiveness.

Civilians in Military Operations

Earlier I mentioned the issue of change. One that we are beginning to see is the trend toward more civilians in areas of operations. This includes both Department of Defense civilians and private contractors. Our recent experiences in Somalia, Rwanda, and Haiti and our ongoing operations in Bosnia illustrate the increasing presence of civilians in military operations. I'm sure this trend will continue, and we'll probably see an ever-increasing level of support that civilians provide.

Combining military and civilian capabilities requires a team effort and a positive approach. You must commit

yourself to integrating civilians into planning efforts from the beginning. Trust is the key and good, two-way communication is needed to build the requisite trust between military personnel and civilians.

Given the size of today's Army, we can't go it alone with strictly military forces. We never have in the past; we've always had civilians supporting military operations in various ways. Granted, we've not had as many civilians involved in military operations in the past, but civilians have always been there. So we need to embrace the trend toward greater civilianization of military operations and figure out how to make it work. Civilians are a positive addition to our military endeavors and essential to successfully accomplishing our missions.

One last thought on this subject. Military-civilian operations are nothing new for the Corps of Engineers, so this is an area where we can share our experience for the benefit of the Army and the nation.

Disaster Operations

I have always been proud of how the Corps of Engineers, both military and civilian, responds to disasters year after year. Whether it's a flood, an earthquake, or a hurricane, we always get more volunteers than we can use to assist in disaster relief. These volunteers respond with all the expertise and professionalism you'd expect, but what's really noticeable is their caring attitude and personal dedication to helping the victims.

Over the years, I've seen the results of many disasters first-hand. In every instance, I cannot begin to express how proud I have been of the Corps team. In the last four years, for example, the Corps played a major role in the aftermath of hurricanes Andrew, Iniki, Opal, and Marilyn. The Corps took part in the recovery from the Los Angeles earthquake and the record Midwest floods of 1993 and 1994. And it provided technical assistance in the wake of the tragic bombings of the World Trade Center and the Murrah Federal Building in Oklahoma City.

It is impossible to predict when or

where the next disaster will occur, but the fact that our people provide superb service to the nation during disasters is part of the reason the Federal Emergency Management Agency (FEMA) frequently calls on the Corps.

Of course, there's also a statutory reason for why FEMA calls on us. Under the Stafford Act, FEMA is responsible for the Federal Response Plan. The Corps is one of 26 federal agencies in that act with disaster-assistance responsibilities. But when FEMA calls on the Corps during disasters, they know our people will be responsive and get the job done!

Stability and Support Operations

Our response to disasters also shows why USACE is ideally suited to render assistance in stability and support operations—the new term for operations other than war. Our command has a wide range of capabilities, and some are unique capabilities not found in industry or other federal agencies. These capabilities run the gamut from engineering, to real estate expertise, to contracting, to project management, and to many others.

In the past four years, this com-

mand provided outstanding service to stability and support operations in Somalia, Rwanda, Haiti, and currently in Bosnia. Some of those operations were humanitarian, some were peacekeeping, and some were nation-assistance. In addition, USACE did work for 91 other countries during the past 12 months, and our people were on the ground in 70 of those countries. This is another example of the responsive, quality service that we can provide the nation across the operational continuum from peace, to stability and support operations, to war.

Contributions to the Nation

Throughout my career, I've seen the many significant contributions the Corps of Engineers has made to the nation. These contributions are the result of our superb people.

Our engineer troops are diversified, talented, and experienced. We can put together a team that can handle whatever might be needed. We truly have a world-class organization that is called on time and again to handle tough missions, and the

Army's engineers have clearly and consistently demonstrated their value to the nation.

The engineer troop units (active duty, reserves, and National Guard) are a vital part of our team. These engineer soldiers are well-trained, highly motivated, and professional. Right now many of these soldiers are in Bosnia. As the NATO Implementation Force (IFOR) moved into Bosnia, we watched engineer bridging operations on the Sava River via CNN. It was a challenging mission, and I was extremely proud of our soldiers as they went about accomplishing their mission.

Perhaps the best testimonial to the quality of the Army's engineer soldiers came from local Bosnians as they watched the Sava bridging operations. The people who live in the area were amazed; first, that anyone would attempt to bridge the Sava in winter; and second, that we would attempt it during flood conditions. Their consensus was that "only the American Army could accomplish such a feat."

Army engineers got the job done under difficult conditions, including cold weather, mud, floods, and a time constraint with the whole world watching. These soldiers were under tremendous pressure, but they were well-trained, they were superbly led,

they followed their doctrine, and they accomplished the mission. You find that throughout the Army's engineer units.

Reserves and National Guard

Speaking of the reserves and National Guard, they comprise about 72 percent of our total engineer strength. Consequently, they are a vital part of our total engineer force, and I need to focus attention on reserve component issues. Brigadier General Anthony R. Kropp, Assistant Chief of Engineers for Reserve Affairs, is helping me do that. When Brigadier General Kropp came on board in September 1995, I charged him to be another set of eyes and ears for me, and he has done an excellent job.



Photo courtesy Far East District

A Corps of Engineers emergency worker assists at the scene of a collapsed department store in Korea last year.



An M1 tank crosses a bridge built by engineers across the Sava River in Bosnia.

He recently hosted a conference for the commanders of the major engineer reserve component commands. The feedback I received from the conference was excellent. I'm sure the conference's output will benefit our Army as we continue to wrestle with the myriad of issues confronting our reserve component engineer forces.

Restructuring

My greatest challenge as the USACE commander has been restructuring the command. It has been a long, frustrating, and emotional process—especially frustrating because we don't control all the variables involved.

Restructuring has weighed heavily on everybody in the command. But I have great confidence in the people of USACE. I know that through their professionalism, dedication, and selfless sense of service, they will deal with restructuring while continuing to provide the responsive engineering services this nation expects.

From my firsthand experience in restructuring during the last six years, I offer the following advice:

First, everyone must realize that restructuring is a continuous process and will probably be with us for quite a while. As I said earlier, we

live in an era of continuous change, so we need to embrace it and make it work for us.

Whatever we do in the restructuring arena, we must maintain a clear focus on our customers. We're not in business to sustain ourselves; we're here to provide service to others. Improving an already superb record of customer service must be our number one priority and the touchstone for all our restructuring efforts.

Coupled with customer focus is mission execution. We must be concerned about how long a project takes, the quality of our product, our cost of doing business, our performance indicators and standards, and whether we're living up to them.

Our intent in restructuring is to enhance both customer service and mission execution. We're not only looking at our organizational structure but also reducing our costs of doing business and reviewing our business processes. Many process changes have already taken place, and others are anticipated.

There have already been some significant organizational changes. We've reduced our divisions from 13 to 11, and we're working on plans to further reduce them to eight. We've reduced our work force from about

41,800 to about 39,300 during the past four years, and further reductions will be required.

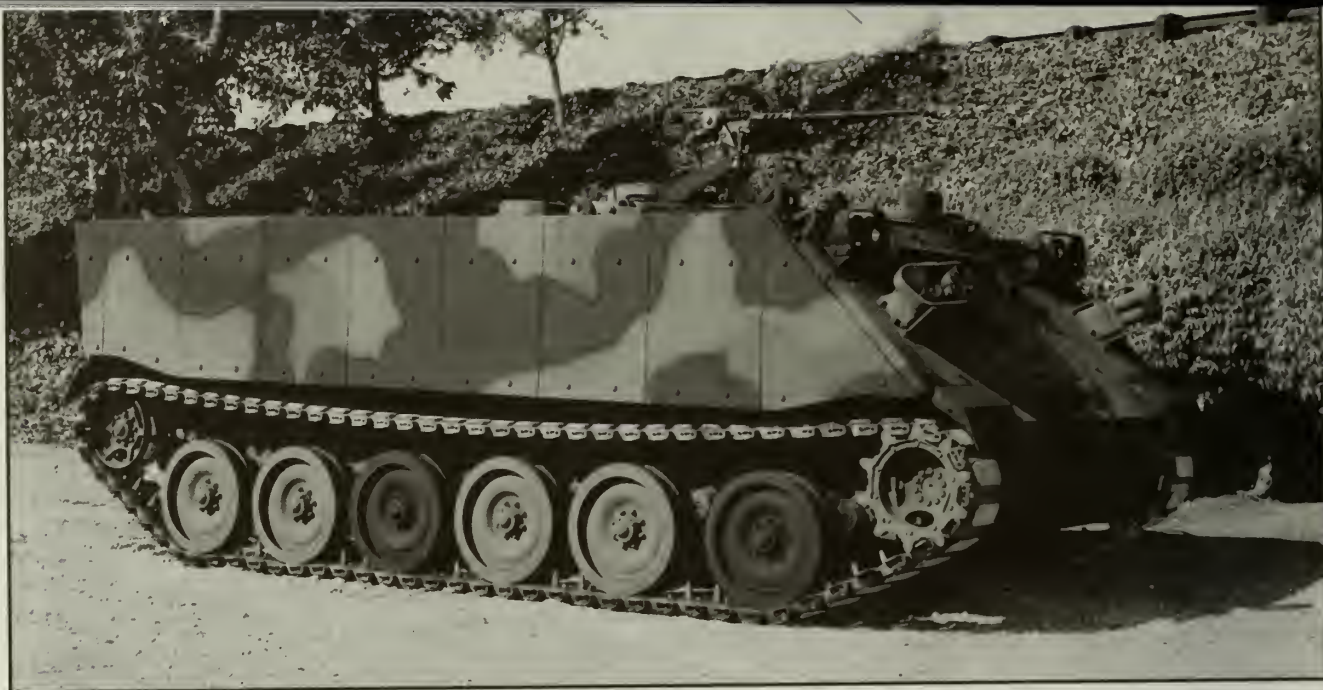
Taking everything into consideration, I think we've done a great job so far in restructuring, but much work remains to be done. Our ultimate restructuring goals are to make sure that we emerge with an effective organization and with quality people who can execute the missions entrusted to us.

In Good Hands

Engineers, both military and civilian, have been a vital part of America's Army for more than 200 years. Their contributions are indelibly recorded in our nation's history. During almost four years as Chief of Engineers, I've seen our engineer family continue that legacy of superb, selfless service. I'm proud to have been part of the Corps family for more than 33 years, and I have no doubt that our future is in good hands.

Essayons! Hoo-Ah!

Lieutenant General Williams has served as Chief of Engineers since 1992.



The Engineer Squad Vehicle

By Major Scott Gourley

Mechanized combat engineer squads have their jobs cut out for them, both on the battlefield and on the way to the battlefield. Many of the in-transit challenges stem from the M113A2 armored personnel carrier, which is the standard carrier for the squad and its equipment. During Operation Desert Storm, three major deficiencies were noted concerning the venerable M113A2.

- Inadequate under-armor payload capacity for the squad members and critical equipment.
- Inferior mobility relative to the supported maneuver force of M1 series Abrams tanks and M2/M3 series Bradleys.
- Insufficient survivability against light and medium direct-fire weapons on the modern battlefield.

One of these deficiencies is being solved with the newly upgraded M113A2s, known as the M113A3, which selected units have already received. First introduced in 1987, the M113A3 features the Reliability Improvement for Selected Equipment (RISE) upgrade package. The RISE upgrades include replacing the existing 212-horsepower diesel engine

in the M113A2 with a 275-horsepower turbocharged diesel engine, coupled with the X-200-4 transmission. This upgrade provides vehicle mobility roughly equivalent to that of the supported M1/M2 maneuver force.

The M113A3 has virtually the same mobility as the Bradley fighting vehicle and the Abrams main battle tank. However, even the M113A3 does not solve the engineer squad's basic dilemmas of stowage and survivability. Because of the amount of equipment they must carry, it is difficult for a fully loaded engineer squad to enter and exit a tracked vehicle easily.

ESV Design

A proposal under consideration will solve the M113A2/A3 deficiencies. The Engineer School is seeking to replace them with a new engineer squad vehicle (ESV). It not only better meets combat engineer requirements but also is convertible from existing M113 systems. This vehicle modification program, supported by the M113 Program Management Office at the Tank-



The ESV provides interior stowage for an entire engineer squad's equipment.

Automotive Command (TACOM), provides a superior squad vehicle at a much lower cost than a new acquisition.

The expanded hull configuration on the ESV prototype is based on the M113A3+ mobile tactical vehicle light (MTVL), which uses an M113 hull that is lengthened 34 inches and equipped with an additional road wheel (six on each side). The vehicle was developed as a "production-tooled demonstrator" with private-industry funding from United Defense.

An industry description notes that "The MTVL / ESV provides more than 60 cubic feet additional volume under armor and increases the payload capacity by up to 7,000 pounds beyond the M113A3. The vehicle's power train consists of a 350-horsepower turbocharged/aftercooled diesel engine driving through an electronically controlled, four-speed, automatic cross-drive transmission. The advanced suspension configuration and aggressive track design provide cross-country mobility that is superior to most combat vehicles over all terrain. Optional modular armor packages provide for up to 30-millimeter (mm) and rifle-propelled-grenade protection. Designed to retain the transportability features of the M113, the MTVL is C-130 roll-on/roll-off transportable and air-droppable."

The lengthened hull and significantly improved power train increase the MTVL's net payload capacity to almost 8 tons. In many cases, this increased capacity eliminates the current requirement for towing a squad equipment trailer or, in worst-case scenarios, for relying on tactical wheeled support vehicles to bring mission equipment forward.

There are significant suspension modifications to the vehicle's lower hull, such as rotating the final drives, raising the sponsons and idlers, and revising the spring and damping rates. In all cases, the new suspension system maintains 100-percent parts commonality with the current M113 vehicle fleet, which is important from both acquisition and supportability standpoints.

The increased payload capacity also allows the engineer squad to solve the remaining deficiency of insufficient battlefield survivability. The basic 5083 aluminum plate hull can be supplemented with a variety of armor packages, such as titanium and steel applique, spaced laminate steel, or ceramic armor tiles. The increased payload capacity is a tremendous advancement in under-armor stowage, while the ability to add things like titanium skin represents a giant leap forward in survivability.

Initial Testing

The Engineer Center began testing the MTVL demonstrator in March 1995. Initial modifications to create the ESV configuration involved changes to both internal and external stowage.

Internal Modifications.

- Tool boxes built into the vehicle were modified to provide easily accessible storage for all engineer tools.
- Stowage for other engineer equipment was modified to allow it to stay in place while traveling cross country over any type of terrain.

External Modifications.

- Cupola armor and additional tie-down locations were added for rucksacks and demolition boxes.
- An easily installed or removed bracket was fabricated to carry concertina wire.

After the stowage modifications were made, the Engineer School used the ESV in a "heavy/light demonstration" at the ENFORCE XXI Conference at Fort Leonard Wood in April 1995. The vehicle supported troops from Fort Drum and Fort Bragg in a simulated assault on an objective. The ESV was one of several vehicles that demonstrated their individual capabilities and were later displayed for the assembled senior leaders.

Field Testing

Following the ENFORCE XXI demonstration, the ESV was assigned to Charlie Company of the 5th Engineer Battalion at Fort Leonard Wood for further testing and evaluation. Charlie Company's sergeant was the vehicle commander during subsequent field operations at Fort Bliss, Texas, (in support of the 3rd Armored Cavalry Regiment) and the National Training Center (NTC) at Fort Irwin, California.

Based on the field tests, the ESV satisfies a number of requirements that have been identified by engineer units. It—

- Allows fully equipped sappers to enter and exit the loaded vehicle quickly.
- Provides sappers with safe battlefield transportation through a ballistic threat of 30-mm direct fire and 155-mm indirect fire.
- Keeps pace with an attacking heavy company over varied terrain when loaded for combat.
- Provides optics for night operations.
- Ensures platform growth to incorporate digital applique and a global positioning system.
- Retains the ability to pull a trailer. While an auxiliary trailer might be required in some mission scenarios, the expanded vehicle would eliminate the current trailer requirement in most combat situations.

Under-armor stowage was not a problem during the field tests. Although the squad size increased from 8 to 10 men with the addition of the Engineer Reconnaissance Acquisition Team, the men and their equipment—10 large rucksacks and duffel bags—fit inside the vehicle. During the live-fire phase at the NTC, the ESV also carried a case of live

C4, a roll of detonation cord, blasting caps, three bangalore sections, the platoon's NBC (nuclear, biological, and chemical) warning equipment, weapon tripods, spare barrel bags, ammunition, and regular engineer equipment (three shovels, three axes, picks, and the pick mattock). It all fit in the vehicle, either strapped down or inside the box. Additional equipment could have been loaded inside if they had strapped the rucksacks to the top and sides of the vehicle. As the mission of combat engineers continues to expand and new equipment is introduced, the need for safe and accessible stowage will continue.

The ESV retains the ability to pull a trailer since some tactical scenarios, such as a rapid transition from offense to defense, could require transportation of additional mines or barrier material. On one field mission, when the unit carried mines and wire to facilitate transition to a defensive operation, the vehicle proved it was up to the challenge. The unit had all its equipment, pulled a trailer, and still kept up with the tanks.

The longer hull of the ESV even facilitates sleeping arrangements in the field. Because of restrictions at NTC about sleeping on the ground, the entire unit slept comfortably in or on the ESV—seven of them inside and three on top. If someone below felt too crowded, he could move to the top of the hull.

The Engineer School's requirements document formalizing the need for the ESV is currently in the sign-off process. Funding to transition the engineers from the M113A3 upgrade program to the M113A3+ ESV program has not been identified yet. With approximately 84 engineer vehicles required in a modern mechanized division, TACOM sources indicate that the initial ESV requirement could range from 300 to 400 vehicles.

U.S. Army combat engineers must continue to update their battlefield equipment. They have long needed an improved squad carrier that provides optimum support to front-line forces. A critical component of the combat engineer system, a carrier serves as a work room, bunker, power tool, and fighting platform for the squad. The ESV will finally provide engineers the capability to support the modern maneuver forces in today's fast-paced conflicts.

Major Gourley is an individual mobilization augmentee. He is a graduate of the Field Artillery Officer Basic and Advanced Courses.

The 1995 Engineer Functional Area Assessment

By Alan Schlie

Ever wonder what happens to the soldiers and equipment of an Army unit when it inactivates? After all, each unit has a specific battlefield mission, and the soldiers and equipment represent the capabilities to accomplish that mission. So if the unit goes away, what happens to those resources?

While the "drawdown" may be the most publicized, it is not the most demanding element affecting a unit's environment. Managing the impacts of modernization—new equipment fielding and training, equipment redistribution, changing doctrine, and reorganization—is by far the most demanding. A unit's environment consists of overlapping domains of doctrine, training, leader development, organization, materiel, and soldiers

(DTLOMS). An action causing a change in any of these domains will affect the other five. And the elimination of an entire unit affects the environment of many other units. Consider the fielding of the first Grizzly: the DTLOMS impacts on the company, the battalion, and the supporting units will be considerable. The Army has a number of procedures to ensure that modernization takes place without adversely affecting the DTLOMS domains.

Modernization Impacts

The answer to the original question, simply stated, is that inactivating a unit moves its resources (soldiers and materiel) into pools from which redistribution is made. But the process

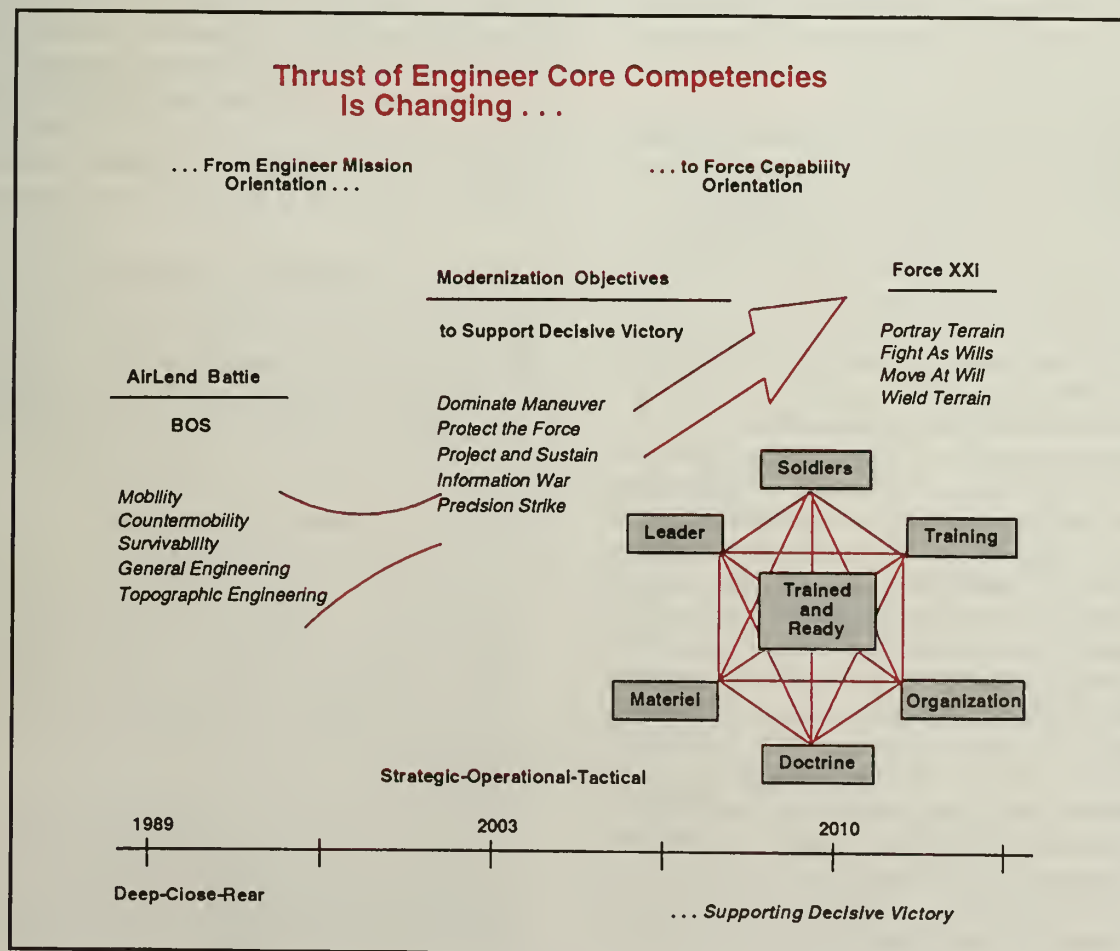


Figure 1

Engineer Battlefield Assessment

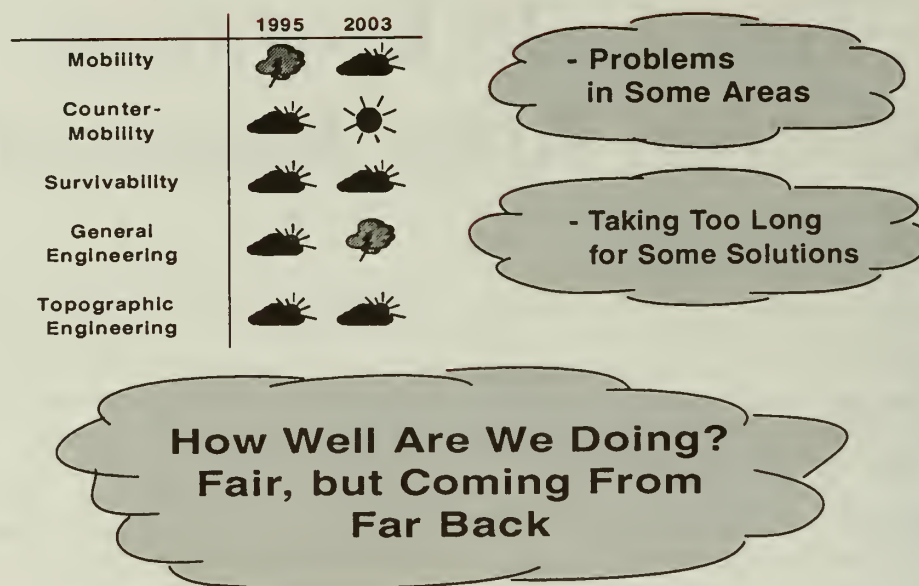


Figure 2

does not always run smoothly, so procedures have been developed to ensure that all actions are completed. Each of the numerous procedures has an oversight mechanism to validate compliance. As an overarching forum, the functional area assessment (FAA) was established years ago so that Army leaders can examine the impacts of force modernization. The focus of the FAA is on how well the force can maintain its readiness and force capability while undergoing change. The FAA ensures that the Army's force integration efforts are accomplished with minimal adverse impacts on readiness, modernization, personnel and training, materiel distribution and redistribution, doctrine application, total force integration, base operations, quality of life, and execution of USC Title 10 functions.

In December 1995, the Engineer School Commandant and the Director of Combat Developments presented the engineer Functional Area Assessment to the Vice Chief of Staff of the Army (VCSA) and key principals from the Army Staff. The presentation highlighted the diversity of responsibilities and missions that engineers accomplish in support of decisive victory (see Figure 1, page 31). As engineer core competencies change from a mission orientation to a force-capability orientation, the need to leverage and integrate technology through sound doctrine, battle-focused training, and effective organizations becomes more acute. Engineers must be viewed as vital, integral members of the combined arms team in the pursuit of a more versatile, capable, and combat-ready Force XXI.

The Commandant addressed the most critical issue facing engineers today—the hemorrhage of

engineers from the Active Component force structure when current operations indicate an ever-increasing requirement (see Figure 2). A 52 percent reduction in Active Component engineers since 1988 impacts our ability to shape the terrain—and terrain is never neutral. Even with the Reserve Components shouldering an increased load, our ability to project and then protect and sustain deployed forces is critically hampered when an immediate response is needed.

Engineer Obstacles

The Commandant discussed seven additional obstacles in the path of engineers and our ability to support decisive victory (see Figure 3, page 33). Each obstacle was examined for impacts on doctrine, training, leader development, organization, materiel, and soldiers. Then the obstacle was balanced against its effect on maintaining the engineering capability during force restructuring.

- Modernization of combat engineer equipment is lagging behind that of the maneuver force. Engineers are equipped with old and slow systems that impact operating and support costs and combat capability.
- There are too few of the new systems, and new equipment fielding in incomplete packages reduces maneuver capabilities. Many current technological insertions could provide a quantitative leap in capability at a much lower cost than the cost of a new system.

Engineer Battlefield Assessment Obstacles

- *Modernization of combat engineer equipment is lagging behind the maneuver force.*
- *Tiered fielding is building incompatible teams.*
- *Aging construction equipment is presenting problems.*
- *Terrain realism is ignored in training, and data is not available for operations.*
- *Countermine is very difficult with solutions taking too long.*
- *Antimine legislation threatens force survivability.*
- *Training base cuts could mortgage our Army in the 21st century.*

Figure 3

- The aging construction fleet affects many proponents and impacts all modernization objectives. Results of a Center for Army Analysis study imply that the Army must spend a minimum of \$50 million annually to improve fleet aging and shortage fill.
- Terrain realism is ignored in training. Current terrain data is not available for operations in more than 95 percent of the world.
- In countermine operations, technology is not the silver bullet. Investigation into the most promising solutions, regardless of the DTLOMS domain, is needed to protect the soldier in the field.
- Antimine legislation strips away the self-protection and freedom-of-action options of the commander.
- A commitment to provide appropriate equipment and training is necessary to properly prepare the next generation of American soldiers.

The FAA presentation was not so much about fixing engineers as it was about optimizing the Army's engineering capabilities.

VCSA Solution

The FAA presenters were successful in obtaining support for numerous battlefield initiatives at a critical time near the beginning of the FY98-03 budget-planning cycle. The VCSA:

- Promised support in programming procurement of the Grizzly, the Wolverine, the Hornet, the Heavy Dry Support Bridge, and 24 other combat programs, plus construction equipment as a whole. The VCSA instructed the Engineer School to move ahead with the technical insertion package for the engineer squad vehicle. He was enthusiastic about the proposed M1-based engineer

vehicle replacement and any other application using the M1 chassis.

- Wanted our full involvement in developing the terrain and engineer play for war simulations.
- Liked the interim contingency operations countermeasure packages. He highlighted the need to invest in countermeasure technologies available now but cautioned about getting a proper return for the investment. Engineers need to leverage the Bosnian requirements to make gains in this area.
- Agreed that current legislation would hinder our operational choices and promised support.
- Encouraged a reevaluation of the requirements generated in the training environment in order to identify more efficiencies.

Using Technology

The Commandant closed the forum by saying, "The Essayons spirit has carried us across many battlefields. It will continue to do so. However, we must not depend overly on the spirit of our soldiers and leaders to support the Force XXI Army. We must seize on technological advances to ensure that we do not place engineer soldiers, units, and missions at unnecessary risk. The Engineer Regiment is trained and ready, a rapidly deployable and versatile member of the strategic force...combining efficiencies of information with physical and technical capabilities to master terrain in support of decisive victory."



CSM (RET) Schlie is a force development analyst with the Directorate of Combat Developments, U.S. Army Engineer School. He served in various capacities in Europe, Korea, and CONUS during a 22-year military career.

Rapid Runway Repair in Need of Repair

By Captain Paul Huszar

Army and Air Force engineer units share responsibility for rapid runway repairs. When conducting such missions, circumstances usually dictate who makes the repairs. In mature theaters—when Air Force assets operate from advanced permanent airfields—Air Force engineers repair the runways to ensure their continuous operation. In forced-entry operations, Army engineers make the repairs so follow-on forces can be airlifted into immature theaters. But when forced-entry operations are into remote theaters with existing advanced runways that need repairs, Army engineers are not equipped or trained to accomplish the mission. They can insert equipment and personnel but lack the proper materials and training to complete the repairs.

This inadequacy was apparent during Operation Restore Democracy—renamed Operation Uphold Democracy when the planned forced entry into Haiti was cancelled. Had a forced entry been necessary, the lack of materials and training could have jeopardized the entire operation.

Defining Responsibility

The downsizing of our armed forces and reliance on the military to fight two simultaneous major regional conflicts means that the smaller force must be strategically deployable. The few forward-deployed units are required to “do more with less,” a familiar phrase in today’s military, and must be able to deploy rapidly. Because joint operations are the norm, intense coordination between the services is needed to ensure that the combined effort will cover every contingency. For example, Air Force or Navy units will transport Army or Marine soldiers into a theater of operations from CONUS bases. In this scenario, the roles and responsibilities are fairly well-defined. However, this is not the case in all contingency scenarios.

Army airborne engineer units parachute personnel and equipment onto an existing airfield to conduct rapid runway repairs. The 20th Engineer Brigade, Fort Bragg, North Carolina, includes this task on its mission essential task list (METL) in support of the XVIII

Airborne Corps’ worldwide contingency mission. Specifically, the 27th and 37th Engineer Combat Battalions (Airborne) train to repair—

- Flight landing strips using air-droppable earth-moving equipment and local sources of soil and aggregate.
- Small craters in more permanent airfields using rapid runway repair kits and the same earth-moving equipment.

After engineer soldiers fill a crater using the earth-moving equipment, they secure the rapid runway repair kit over the crater to prohibit foreign object damage (FOD). They repair a runway to the standard that allows C-130s to land.

As plans for Operation Restore Democracy unfolded and the intelligence preparation of the battlefield developed, XVIII Airborne Corps planners realized that the Haitian military might crater the runway at Port-au-Prince International Airport. After seizing the airport in an airborne assault, the U.S. military planned to use it as the main point of embarkation for personnel into the theater. One concern was that if the Haitians packed demolitions in the

culverts beneath the runway, the resulting craters would be too large for Army engineers to repair with rapid runway repair kits. The operating strip that remained would be useless for all aircraft except C-130s.

This scenario fits within the realm of missions for Air Force engineers, because the existing concrete runway in Haiti would serve as an international airport. However, the XVIII Airborne Corps' plan included a forced-entry operation with an airborne assault onto Port-au-Prince Airport with follow-on forces arriving immediately in C-141s, C-5s, and Civil Reserve Air Fleet aircraft. Therefore an Army unit—Alpha Company, 37th Engineer Battalion—received the mission to repair the runway at the Port-au-Prince Airport. The unit prepared a

heavy airfield repair package (HARP) to be air-dropped onto the airfield (see table).

Training

The assistant corps engineer section of the 20th Engineer Brigade staff coordinated with units at adjacent Pope and Tyndall Air Force Bases to train soldiers from Alpha Company and provide them with the necessary materials and equipment. Officers from the 37th had seen the Air Force's methods and equipment demonstrated six months earlier, but soldiers from the battalion had never used these tactics, techniques, and procedures. Alpha Company trained on the unique equipment and materials for only three days before leaving Fort Bragg for the intermediate staging base.

Repair Technique

The Air Force repair technique includes filling cratered holes in much the same way as Army units do. However, the FOD cover is much different for large craters. The flexible fiberglass matting is 30 feet wide and is stacked accordion style. Two Air Force 10K John Deere forklifts and a crew of soldiers unfold the matting. These forklifts differ greatly from the Army's Caterpillar 950B 2.5-cubic-yard loaders with detachable buckets and attached tines. The tines on the Army's Caterpillar are less maneuverable than the forks on the Air Force's John Deere, which makes positioning the flexible fiberglass matting more difficult. However, the Army's loaders are air-droppable. The air compressor, tools, and materials required to anchor it to the existing surface are included with the matting. The matting does not distribute a load but provides the necessary FOD cover, essential to the jet transports used in the XVIII Airborne Corps deployment.

Personnel and the HARP, except for the matting, were loaded on 13 C-130s. If the Haitians cratered the runway and the airborne assault force called the HARP forward, it would be air-dropped onto Port-au-Prince International Airport.

The Airborne Test Board at Fort Bragg develops procedures to air-drop new equipment. The agency had rigged and tested the matting for the airdrop but had not refined the procedure. Therefore, the matting could not be parachuted in with the rest of the equipment.

Heavy Airfield Repair Package

Quantity	Equipment
2	950B loaders
2	D5B bulldozers
1	130G grader
1	Small emplacement excavator
2	M929A2 5-ton dump trucks
1	HMMWV
1	250-CFM air compressor
1	13-wheel towed roller
3	500-gallon fuel blivets with pumps and hoses
2	12-foot mass supply boxes with tools and supplies
3	Sections of flexible fiberglass matting with tools and materials



Soldiers from the 37th Engineer Battalion (Cbt) (Abn) prepare a D5 bulldozer to be air-dropped.

Air Force loadmasters and Army riggers decided to rig the matting on a pallet train consisting of four 463L pallets and load it on a C-130, which would land at Port-au-Prince Airport. They rigged the sections individually, each with a two-loop, 20-foot nylon sling attached. This would allow the top section to be unhooked and dragged off while the rest remained attached to the pallet train, which was locked in place in the aircraft.

Since the 25K loaders normally used to load and unload C-130s would not be available in Haiti, soldiers would use equipment air-dropped to the island to unload the matting. They would drag the sections off with a 950B loader hooked to the nylon slings on each section.

Delivery of the flexible fiberglass matting relied on the assumption that the runway in Haiti would be C-130-capable. If the Haitian Army cratered the runway at the culverts, then they might also crater it in other places to prohibit a C-130 from landing. This risk

was accepted. Using the air-dropped equipment to make minimal repairs would bring the runway up to C-130 standards and allow the first plane to land with the matting needed to make additional repairs to the runway. However, this procedure would slow the arrival of follow-on forces and interfere with the XVIII Airborne Corps' plan and synchronization.

Ensuring Mobility

Planning and preparing for Operation Restore Democracy highlighted the need to refine the rapid-runway-repair capabilities of Army engineers. Further coordination among all the services is necessary to ensure that Army engineers can perform rapid-runway-repair missions in a forced-entry operation—the type formerly thought to be solely an Air Force engineer responsibility. Army engineer units with rapid runway repair as part of their METL need the

same equipment, materials, and training as Air Force engineers with similar missions. Army engineers also need a comparable method of air-dropping flexible fiberglass matting.

A primarily CONUS-based force that is strategically mobile will rely on airlifts into theaters of operation. This mobility increases the need for rapid runway repair so that U.S. armed forces can deploy rapidly regardless of the type of arrival airfield. With the proper equipment, training, and materials, we can ensure the strategic mobility of our armed forces.



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Battle Command Knowledge and Skill

By Major George DeMarse

"War is not an affair of chance. A great deal of knowledge, study, and meditation is necessary to conduct it well."

Frederick The Great:
Instructions for His Generals,
1747

The art and science of command is a subject well-versed in the minds and hearts of military historians, leaders, and soldiers. Many books provide thought-provoking stories about military leadership. As members of a profession of arms, officers of all ranks are encouraged to study, contemplate, and debate about war and leadership. Nothing should be more important to us. For at the forefront of our profession, I believe, is the leader's desire and ability to lead soldiers on the battlefield.

FM 100-5, *Operations*, highlights the importance of leadership with the doctrinal term *battle command*. Its definition focuses on the art of leadership: the ability to influence and to make timely and accurate decisions; and the ability

to assimilate information, understand the situation, and develop a clear picture of the battlefield through time and space.

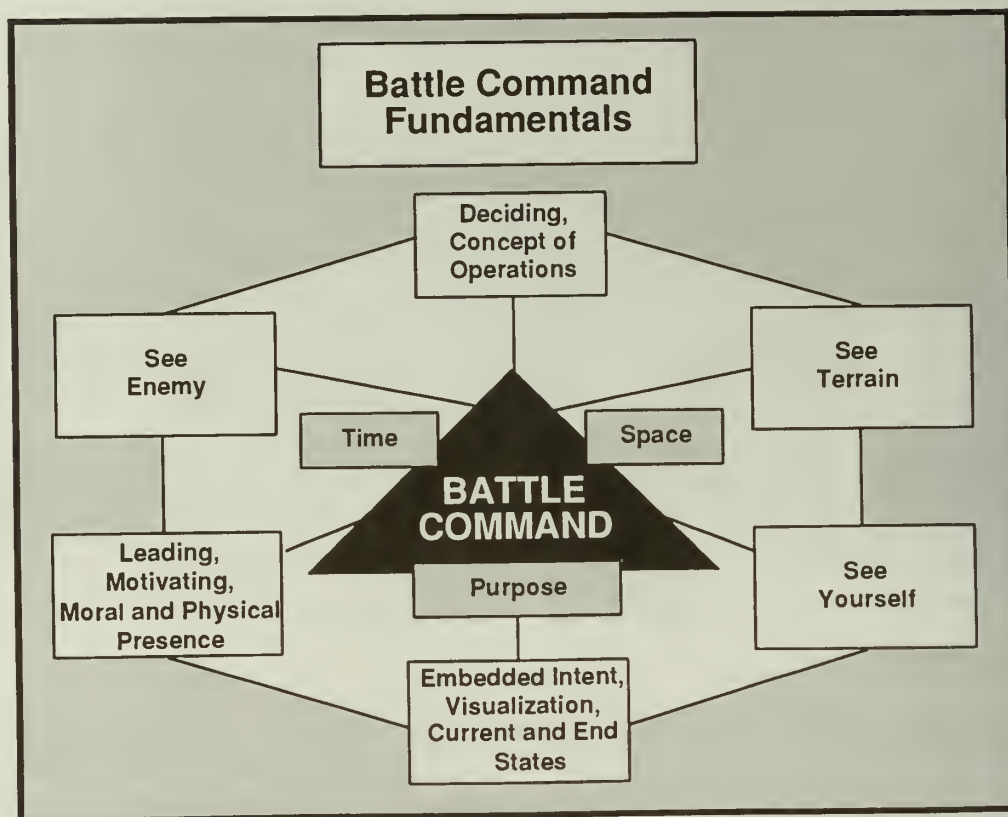
I have observed leaders—in combat, in field exercises, and at the National Training Center—demonstrate their mettle while planning, preparing, and executing combat operations. This article is based on my understanding of what leaders must know and practice to achieve success on the battlefield.

Know Your Business

We often hear that leaders must be technically and tactically proficient. What does it really mean, in absolute terms, to be well-versed in tactics? A seasoned tactician is normally someone who has developed knowledge and skill through study and practice. He consistently reads doctrine and applies the guidelines to his advantage. He understands that there are no short cuts, a point that cannot be overemphasized.

From the platoon leader to the top of the command chain, doctrinal knowledge is the precursor to developing intuitive combat-leading skills. For example, understanding troop-leading procedures, the parallel planning process, the estimate of the situation, and the role of other battlefield functions requires extensive reading and discussion. Periodically reviewing doctrinal material refreshes our memory and strengthens our knowledge base. We first learn to talk about and understand doctrine before we apply it in the field. Crawl, walk, and run certainly applies here; the learning process begins as a junior leader and never ends.

Knowing your business, however, involves more than just reading doctrinal manuals. Learning also comes from military publications, history books, technical manuals, after action reviews (AARs), and respected mentors. Being part of the AAR process is a great learning experience, and information recorded can be pon-



dered later. Watching AARs and writing pertinent learning points in my spiral notepad has been very useful to me.

We should also obtain up-to-date manuals applicable to our unit and read and reread the material. For example, an engineer company commander in an armored division should have manuals that provide information about his organization and equipment as well as those covering the units he will support and fight. Two important ones are FM 34-130, *Intelligence Preparation of the Battlefield*, which helps to understand the IPB process; and FM 6-20-40, *Fire Support for Brigade Operations*, which provides information on fire-support capabilities and how fire supporters plan artillery-scatterable minefields.

Timing Is Everything

Knowing where you need to go and what you need to do when you get there is essential to being an effective battle commander. A fundamental concept of battle command (see figure) is to know where to position key players on the battlefield. A commander must keep them focused on his critical task list; he must maintain the reins and keep them in "their lanes." Only then can he really see the terrain, himself, and the enemy. And only then can he influence the desired outcome of the battle—to capture or kill the enemy and win.

Can this be taught in the classroom, or must it be learned on the battlefield? I believe it's a combination of both. Although doctrinal proficiency is the foundation for the proper application of a leader's battle-command skills, the ability

to react intuitively results primarily from experience and observation. Field training becomes a template to confirm or deny his ability to lead soldiers in combat.

For example, a company or battalion commander always provides guidance concerning priority intelligence requirements (PIR) and critical information requirements. These requirements are usually influenced by higher headquarters. Nevertheless, the commander's guidance sets the conditions for when and where other players will participate and influences the planning process. Engineer PIR may not become the maneuver commander's PIR. The engineer XO and the S2 interact with their maneuver counterparts to ensure that engineer requirements are met. PIR is useless if it isn't a product of event templating and a major part of the reconnaissance



Commanders rehearse actions on the objective.

and surveillance plan. The engineer XO must guide the S2 through the IPB process and ensure that intelligence information is gathered at the right time and place.

Time lines are the best tools to ensure that combat operations are planned, prepared, and executed "on time." The time line is developed during mission analysis and is influenced by the supported headquarters. The supported unit dictates the planning process and influences the ability to conduct parallel planning. It is important to remember that the purpose of parallel planning is to provide timely and accurate information to our subordinates. They must know enemy capabilities, terrain considerations for positioning combat and support elements, intelligence templates, time and distance requirements, and engineer critical tasks to conduct their planning.

Mission analysis determines every task that must be accom-

plished to ensure mission success. Tasks involve degrees of coordination and synchronization. To be successful, engineers must understand how other combined arms elements—such as artillery, close air support, air defense, medical support, and logistics—support their mission. Know their capabilities and know when and where you need them to get the desired effect.

For example, artillery radar can support engineer soldiers in the offense and the defense. The tough part is coordinating and synchronizing the support. You should know that a Q36 has a maximum range of 15 kilometers for mortars and 24 kilometers for artillery and rockets. You must war-game to determine when and where you need the radar cueing, or it will not happen. Combat engineers in the attack at the point of penetration, and engineer systems like the Volcano in the defense, are high-value targets to the enemy.

"Know the enemy, know yourself; your victory will never be endangered. Know the ground, know the weather; your victory will then be total."

Sun Tzu: The Art of War
400-320 B.C.

Understand Your Role

The commander provides guidance that generates the actions required to exercise his battle-command skills through processes known as troop-leading procedures, IPB, tactical decision making, and METT-T (mission, enemy, terrain, troops, and time available). He sets the stage for how his key players function. From the planning to the execution phases, his team provides information needed to direct and lead. These processes allow the commander and his staff or subordinates to gather facts and assumptions as they apply to the enemy, friendly forces, and the terrain. Through it all, the com-

During mission analysis, the commander's guidance sets the conditions for how he will visualize the battle.

mander hopes to visualize a clear task, a purpose, and an end state.

Tactical decision making follows a prescribed process and involves steps a commander must influence. As the main cog, his guidance and intent provide the focus for staff/subordinate planning. During mission analysis, the commander's guidance sets the conditions for how he will visualize the battle. Each staff officer and subordinate has a clear task and purpose for each phase of the operation (see Table 3-2, FM 5-71-3, *Brigade Engineer Combat Operations [Armored]*). Key players understand their critical tasks and how to integrate and synchronize them. The commander further articulates his critical information requirements and establishes the communication network to control and disseminate timely information.

From implied, specified, and essential tasks to the restated mission, the commander is the decision maker. He determines the unit's task, purpose, and end state. Nothing is more important to effective horizontal and vertical planning. The commander's direction during mission analysis sets the stage for timely and accurate integration and synchronization. Staff officers and subordinates must understand when and where to focus their skills.

An engineer commander's presence at a battalion or brigade command post must influence the decision-making process. He doesn't relinquish this responsi-

bility to anyone. He "steps up to the plate" and lets everyone know who's in charge. It's important to note that a commander's ability to physically influence the planning process is a product of operational tempo. There are times when much of his influence is transmitted from another location. But a strong commander can make his presence felt from 25 kilometers away.

The commander's ability to recognize critical tasks during planning, preparing, and executing combat operations can determine success or failure. His ability to influence those critical tasks will enhance success. Once again, the commander's presence becomes an influential and motivational force. He ensures that subordinates understand their part of the operation. He is an active participant throughout every phase of the operation.

Once the plan is set, the commander focuses his attention on preparing his forces for the upcoming mission. Key players continue to monitor the situation and develop the picture. During the preparatory phase, much effort goes into organizing personnel and equipment. This effort involves much more than simply affixing an overall task organization. The commander is not only concerned with arraying his forces but also with ensuring that his subordinates understand his intent. The preparatory phase has many moving pieces, but the commander and his staff must stay

focused on the critical tasks.

The unit's time line establishes when and where tasks are executed. Inspections, rehearsals, and back briefs are highlighted and performed. The preparation phase sets the conditions for successful execution. This is the commander's last opportunity to integrate and synchronize his battlefield functions. Time will influence how the preparatory tasks are performed (for example, face-to-face or by radio). Once his forces cross the line of departure, a commander loses some of his influence. Frequently, the preparatory phase is his last opportunity to physically direct and influence subordinates.

Time, space, and purpose are set before the battle begins. From actions on the objective back to the line of departure, constant attention is given to synchronizing when and where units apply their capabilities to achieve the commander's intent. Back briefs to the commander discuss when and where critical events are executed. As the battle rehearsal plays out, the commander visualizes the execution of the battle. He sees the effects of the terrain and the capabilities of the enemy and his own forces. He considers options based on other conditions and contingencies.

Once the battle begins, the commander positions himself where he can best communicate with and direct his unit. Information flow is critical. Command and control facilities assist him in

monitoring the situation. Situational awareness becomes the operative focus for everyone. Every action is geared toward informing commanders about significant changes to the situation. Updates on unit strengths, enemy locations and activities, decision points, and other critical information requirements are transmitted. Changes in status normally correspond to changes in capability. Commanders use the information to reassess the situation and anticipate other contingencies.

Conclusion

Battle commanders cannot do it alone. Combat is a team sport. A commander's vision of the battle is refined and updated by the key players on the team. They continually gather, analyze, and disseminate critical information. War-gaming sessions produce a clear picture of when and where to apply unit capabilities to achieve desired results. Maintaining a clear picture is a team effort throughout planning, preparing, and executing combat operations. I believe that an appreciation for doctrine (employing doctrine to your advantage) and constantly keeping your head down and in the ball game will enhance your odds of accurately estimating the outcome and decisively winning any battle.

With the advent of Force XXI and digitization, some people believe that information technology will transform the way commanders and staffs plan, prepare, and execute combat missions—that the current mode of decision making will be replaced by another process or application. Whatever the change, the fundamentals of battle command will remain the same. A commander's

ability to develop a vision is a product of his knowledge and skill. Knowledge is a product of doctrinal proficiency. Skill results from practicing and observing the application of doctrine. There are no short cuts. In my opinion, those who neglect this most critical principle of our profession should not be leading soldiers.

Force XXI is a reminder that our profession is ever-changing; that our battle-command skills are perishable and replaceable; and that skill is truly a product of knowledge. We must never rest on our laurels but continually challenge ourselves to stay the course. While that's not easy, the battlefield will be our friend if we persist. Then it will be the enemy who suffers the consequences.

"No study is possible on the battlefield; one does there simply what one can in order to apply what one knows. Therefore, in order to do even a little, one has already to know a great deal and know it well."

Ferdinand Foch: Principles of War, 1919



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(Personal Viewpoint, continued)

benefits. Engineers from all services have broadened their knowledge of construction equipment they may operate in future joint operations, and they have learned to appreciate the other services' engineer capabilities. It is critical that all military engineers fully understand the other services' engineer capabilities and be able to integrate them into operational plans. The ability to successfully integrate engineer equipment was key to successful military operations in Bosnia, Haiti, Somalia and the Gulf War.

To remedy these deficiencies, all parties must first recognize and agree that things are no longer owned or directed by a single service. The word "I" must be replaced with "We". Individuals must avoid the tendency to refuse to consider anything except what they perceive as "their" service's position. In the joint environment, the methodology for decision making must be one of consensus building without demands for unique positions that benefit a single service.

The Future. Joint service training is an exciting initiative at Fort Leonard Wood. It is at the cutting edge of interservice cooperation and compatibility. Although there are challenges, this program of shared resources is now a reality. Our overall goal has not changed: to produce outstanding, well-trained, and well-qualified engineer equipment operators and technical engineering specialists for all military services. At Fort Leonard Wood we are making this goal a reality.

Captain Danner is commander of B Company, 577th Engineer Battalion, 1st Engineer Brigade, Fort Leonard Wood. He previously served as platoon leader in the 10th Engineer Battalion, USAREUR, and the 1st Engineer Battalion in Southwest Asia. A graduate of the University of Idaho, CPT Danner has completed the Combined Arms and Services Staff School.

Wherry and Capehart: Army Family Housing Privatization Programs in the 1950s

By William C. Baldwin

The Secretary of Defense, William J. Perry, has made improving military housing one of his highest priorities. Because the job is so big, he wants to enlist the help of the private sector. Using the resources of private industry to improve military family housing is not new. In the long, eventful, and often neglected history of military housing, the Defense Department has tapped the resources of the private market to expand the housing stock of the Army and the other services. In the last decade, the so-called Sections 801 and 802 housing programs gave Army families increased access to adequate and affordable housing.

Four decades ago, two even larger programs relied on private financing to vastly expand the Defense Department's family housing. They produced much of the housing in the Army's now aging inventory. The names of the U.S. senators who sponsored the legislation creating the two programs, Wherry and Capehart, are familiar terms in the Army community. The origins and natures of the Wherry and Capehart programs, however, are less well understood, and the lessons learned from those programs, which could be useful to current decision makers, are often inaccessible or misunderstood.

After World War II, the peacetime Army was many times the size of the peacetime Army of the

1930s. The Cold War and the Korean Conflict ensured that the Army, even during the lean years of the Eisenhower administration, would be the largest peacetime Army in our nation's history. Although family housing had grown during the 1920s and 1930s, it was barely adequate for its day and was clearly inadequate for the expanded Army of the Cold War.

Government leaders struggled to provide adequate housing for eligible families by building trailer parks and adapting wartime temporary buildings, but these improvised measures were not enough. After the huge expenditures of World War II, Congress was reluctant to pay for large numbers of government quarters. The plight of inadequately, even scandalously, housed Army families finally made the pages of *Life* magazine in 1949, complete with photographs. In response to this desperate situation, Congress and the administration devised an innovative housing program in 1949.

Senator Kenneth S. Wherry, a Republican from Nebraska who served in the Senate from 1942 until his death in 1951, sponsored the bill that became law when President Harry S. Truman signed it on 8 August 1949. Under Wherry's program, businessmen, called private sponsors, built and then operated and maintained housing projects on or near military installations. Army families

could choose to rent the housing using their basic allowance for quarters. Based on the cost of building and maintaining the housing, the rent could exceed the soldier's housing allowance. The private sponsors built most of the Wherry housing on military bases, where they leased the land from the Defense Department for a nominal fee (see photo).

The financing arrangements for Wherry housing were rather complicated. The military service advertised a proposed housing project, and the winning bidder became a private sponsor. Equipped with a certificate from the Secretary of Defense, who asserted that the service needed the housing and had no plans to close the base, the private sponsor obtained mortgage insurance from the Federal Housing Administration (FHA). Armed with this special insurance, the sponsor then sought money to build the project from the private mortgage market.

Congress limited the average cost of each housing unit to \$9,000, a reasonable amount in the early 1950s. The average mortgage per unit, however, was limited to \$8,100. Because the private sponsor had \$900 of his own money tied up in each unit, Congress thought that would be an incentive for the sponsor to build and maintain good housing. Many sponsors, however, tried to build units for \$8,100 or less. They hoped to make a profit both on



Wherry Housing at Fort Dix, New Jersey



Capehart Housing at Fort Devens, Massachusetts



Capehart Housing at Fort Dix, New Jersey

"The Wherry and Capehart programs produced more than 55,000 housing units for the Army and created a 'boom' generation of Army housing that is now showing its age."

constructing the housing and on operating and maintaining it for the full term of the lease, which typically ran for 50 years (and sometimes for 75 years). Housing costs escalated in the 1950s as a result of the nationwide postwar housing boom, and Wherry units soon were recognized as small and inexpensive housing.

The different expectations of the program's proponents and the private sponsors eventually killed the Wherry program. In 1953 and 1954, Congress changed the program to require that sponsors refund the "excess" profits they made from constructing housing for \$8,100 or less. By 1954 interest in becoming a Wherry private sponsor had diminished greatly.

In 1955 Senator Homer Capehart, a Republican from Indiana who served in the Senate from 1944 through 1962, sponsored a new housing program. Under the Capehart program, which became law on 11 August 1955, private sponsors built housing but did not operate or maintain it. Again the services advertised housing projects, and the winning bidders obtained mortgage insurance from the FHA on the entire amount of their bids. With this insurance, the sponsors obtained financing in the private mortgage market for 25-year mortgages. When a sponsor completed construction, the company transferred the mortgage to the Department of Defense.

Under the Capehart program, the average housing unit cost \$13,500, a limit Congress raised

to \$16,500 in 1956 (see photos). The services assigned military families to the Capehart housing and used the forfeited housing allowances to make the mortgage payments. Money for operating and maintaining the units came from appropriated funds.

The private owners of Wherry housing projects opposed the Capehart program because they feared the services would favor the new, better housing and leave their Wherry units with high vacancy rates. Congress finally required the services to buy the Wherry units on installations where they built Capehart units, but the Wherry owners and the government struggled for years to determine a fair price for them. The struggle left the Wherry owners bitter and led one of their representatives to declare that "The military and private enterprise are not compatible in the field of ownership and management of military housing."

After some initial problems, the simpler Capehart program succeeded in providing the Army with 36,000 housing units by the early 1960s. But Capehart housing had its critics also. Some argued that this housing was more expensive than comparable units built with appropriated funds. Senator Capehart responded that, with all the demands placed upon it, the Defense Department could not sustain a long-term program for housing construction with appropriated funds. Senator Richard Russell of Georgia accused some private sponsors of "sharp practices." Senator Harry Byrd of

Virginia described the program as "...the worst case of back-door spending that has come to my knowledge." In 1961 the Senate voted not to renew the Capehart program but, in a compromise with the House of Representatives, extended it until 1 October 1962. In that year Congress voted to build military family housing with appropriated funds.

Together, the Wherry and Capehart programs produced more than 55,000 housing units for the Army and created a "boom" generation of Army housing that is now showing its age. The Defense Department consistently maintained that it preferred to construct housing with appropriated funds but was grateful for any housing that improved the quality of life for military families. Although Congress promised in 1962 to continue constructing large numbers of housing units with military construction funds, the war in Southeast Asia and other priorities soon brought the Defense Department's post-World War II housing boom to an end, just as Senator Capehart had warned. Instead of replacing the cyclical pattern of military housing programs, the Wherry and Capehart programs became just another, if somewhat longer, cycle in the long boom-or-bust history of Army housing.

Dr. William C. Baldwin is a historian in the Office of History, U.S. Army Corps of Engineers, Alexandria, Virginia. He is researching and writing a history of Army housing.



By Command Sergeant Major Julius B. Nutter
U.S. Army Engineer School

Force XXI Leader Development

The Chief of Staff of the U.S. Army has stated that training is the glue that holds the Army together.

Trained leaders are essential to molding skilled individuals into effective teams and in combining teams into combat-ready platoons, companies, and task forces. A key ingredient to well-trained units is trained leaders.

As I assume my duties as Command Sergeant Major of the Engineer Center and Fort Leonard Wood, I fully support this philosophy. Over the next few years, I will focus my efforts to ensure areas of training are developed and implemented to successfully accomplish the missions and goals of the Force XXI Army.

As the Engineer Regiment designs institutional leader-development programs, proponent school leaders must remain cognizant of what will be expected of 21st century leaders. They must be trained to fight and win our nation's wars. They must also operate in an environment of complexity, ambiguity, and rapid change; be capable of building effective teams amid continuous organizational and technological changes; and be proficient at adapting and solving problems creatively.

While working to develop dynamic training to meet the needs of 21st century engineer soldiers, Army leaders also must remain committed to the basics that make our Army great:

- Sustain Army ethics.
- Lead, train, maintain, and care for soldiers.
- Foster enduring values (courage, candor, competence, commitment, and compassion).
- Train to rigorous standards.
- Train as we fight.

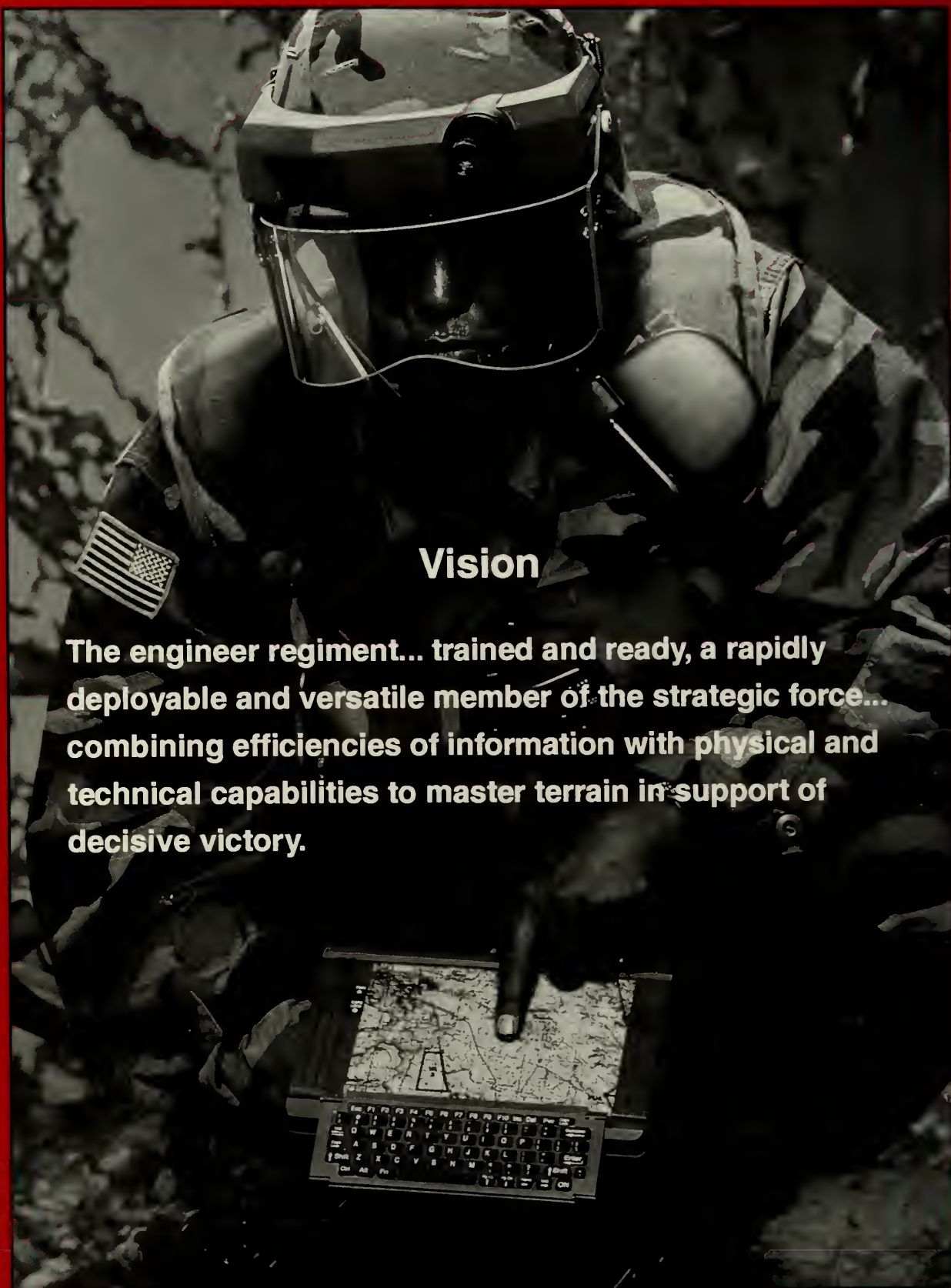
The leader-training concept of operations requires that noncommissioned officers (NCOs) integrate the three leader-development principles—institutional training, operational assignments, and self-development—because each of them supports, reinforces, and sometimes overlaps the others. We must also use information technology and techniques to maximize the learning experience. For example, we will increase the training and operational requirements of our efforts by ensuring the proper sequence, time, focus, and location of training, education, and assignments. Finally, we must be resource-efficient and learn from ongoing operations, Force XXI initiatives, and the Army's strategic outreach program.

In November 1995, the Advanced Noncommissioned Officer Course (ANCOC) for engineers was restructured to better focus on the concept of leader development for Force XXI. The following subjects were added to the ANCOC program of instruction (POI); together they add one week to the course curriculum at Fort Leonard Wood.

<u>ANCOC POI Changes</u>	<u>Hours</u>
- Plans and Orders	3
- Breaching Techniques	2
- Engineer Tactical Planning	3
- Task Force Engineer Responsibilities and Duties	2
- Engineer Capabilities	2
- Engineer Support to Offensive Operations	3
- Offensive Operations Practical Exercise	8
- Offensive Operations Tactical Exercise Without Troops (TEWT)	8
- Engineer Support to Defensive Operations	3
- Obstacle Tactics	2
- Defensive Operations Practical Exercise	8
- Defensive Operations TEWT	8
- Engineer Support to Army Operations	4
- Obtain Combat Service Support	1
- Conduct Defensive Operations	3
- Conduct Offensive Operations	2
- River Crossing	2
- Threat Tactics	2
- Determine Division Organization	3
- Tactics Examination	3

Force XXI engineer NCOs must be competent in current engineer doctrine and task-force engineer operations and possess the skills, knowledge, and attitudes needed to support the digitized battlefield. The new ANCOC structure supports this vision. I encourage NCO leaders throughout our Corps to remain aware of technology and doctrinal changes to ensure that today's NCOs are prepared for the Army of the 21st century.

The Engineer Regiment



Vision

The engineer regiment... trained and ready, a rapidly deployable and versatile member of the strategic force... combining efficiencies of information with physical and technical capabilities to master terrain in support of decisive victory.

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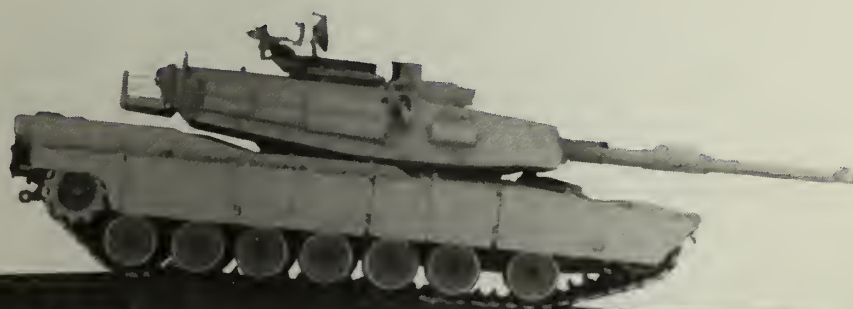
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Engineer

THE PROFESSIONAL BULLETIN FOR ARMY ENGINEERS

August 1996

THE WOLVERINE



DEPOSITORY

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UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN



25th Anniversary Issue

Headquarters, Department of the Army
PB 5-96-3 Approved for public release; distribution is unlimited.



CLEAR THE WAY

By Major General Clair F. Gill
Commandant, U.S. Army Engineer School

This year marks the 25th anniversary of *Engineer*. Since the first issue was published at Fort Belvoir in the spring of 1971, the format and content of our magazine have changed somewhat but the main purpose has remained the same—to provide an effective and responsive means of open communication between military and civilian engineers throughout the Corps of Engineers. In that first issue, Major General Robert R. Ploger, then Commandant of the U.S. Army Engineer School, clearly stated the reason for *Engineer's* existence:

"We of the Corps of Engineers have long been waiting for the advent of a forum to air our ideas on current engineering problems—military problems as well as those within the civilian domain."

We are optimistic that we now have such a vehicle, with the initial issue of The Engineer making its debut on the engineering scene.

Through this medium, we hope to trigger engineer thinking. We hope to stimulate controversial subjects; "cross-generate"—if you will—engineer viewpoints, with the objective in mind of progress in the profession. Certainly there are among us engineers who can rebut or reply to questions such as:

- *Should engineers be generalists or specialists...*
- *Can we attain trade union recognized proficiency for our MOS specialists...*
- *What is the best method of reducing response time...*

We would like to see such topics—and countless others—explored and we believe that this can be done effectively through future issues of The Engineer.

Controversy for controversy sake? No—that is not our objective. What we are after is progressive engineering thought, and we feel that we shall be successful in reaching that goal. We see The Engineer as a reflection of contemporary thinking, engineering-wise. It will be edited with the aim of provoking the thought processes of the complete span of our personnel, from young enlisted men to career-oriented engineer officers. From them may well emanate new ideas, fresh approaches to existing problem areas—solutions perhaps, to many of the technical barricades facing us.

With that in mind, an epigram occurs to us (and we are speaking in terms of engineering problems):

'Problems known by all are prevented from growing tall.'

In essence, this means that discussion invites solutions, and we want to stimulate discussion in The Engineer.

Remember, The Engineer constitutes an open engineer forum. We hope that those who are in the business, will give us the business! Your help is solicited. Input is desired from all engineers who wish to serve the interest of our Army and nation.

Let us hear from you!"

As we celebrate this silver anniversary, I reflect with pride that MG Ploger's far-sighted ideas have served us well for a quarter of a century and are still valid today. Our readership is expanding to engineers in other services as the shift toward joint training and more frequent joint operations continues, and we welcome those new readers. To them and to those in our traditional Army engineer family the *Engineer* staff and I extend a hearty "Thank you!" for supporting our magazine. *Engineer* will remain an effective forum for exchanging information within our engineering community as long as you submit your thoughts and ideas, so keep the manuscripts coming. This is your professional journal, and it will be as good as you want to make it.

On a more serious note, I will speak briefly about the impacts of the President's ban on antipersonnel land mines. President Clinton announced a unilateral U.S. policy on 16 May 1996 that immediately ends the use of non-self-destructing antipersonnel land mines by U.S. forces. The policy makes two narrow exceptions:

- We can continue to use the otherwise prohibited mines as "training aids" in countermine training and in humanitarian demining training.
- Because of the unique challenge of defending Korea, we can use and train with the otherwise prohibited mines in this theater.

While the policy is clear, the details and impacts are still being worked. Many issues, such as the "demilitarization" of prohibited mine inventories, are outside of Army engineer channels. Other issues, such as training the force in Korea and all other personnel and rewriting our mine-warfare doctrine, do involve Army engineers, and they are being discussed, coordinated, and resolved. Specific changes will be described in detail in future issues of *Engineer* and in other professional journals. Stay tuned for later developments!

Engineer

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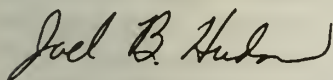
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Cover: The cornerstones of engineer modernization for the heavy force, the Wolverine heavy assault bridge and the Grizzly complex obstacle breacher, are featured on the front and back covers.

Photo credits: Wolverine photos courtesy of General Dynamics Land Systems Division. Grizzly photos courtesy of U.S. Army Test and Experiment Command.

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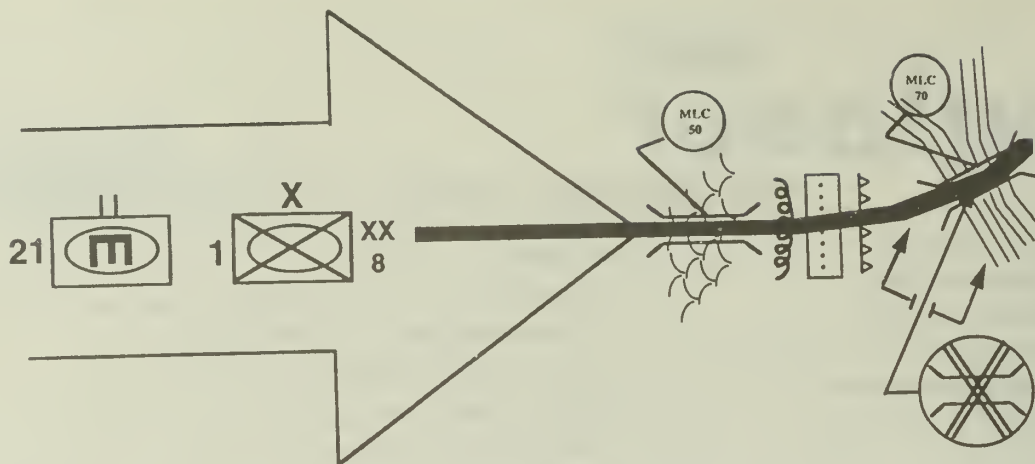
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The Grizzly and the Wolverine:

Alternatives to an Orchestrated Ballet of Farm Implements

By Major Harry Greene

The activities of engineers in the breach have been described as “an orchestrated ballet of farm implements.”¹ The capability of engineers to provide responsive mobility support to the heavy division is a well-known area of concern. The Engineer Regiment’s top two materiel development priorities, the Grizzly and the Wolverine, are designed to alleviate those concerns. The following scenario contrasts the “orchestrated ballet” of today to the future of the regiment with the Grizzly and the Wolverine.

Circa 2006

The 1st Brigade of the 8th Infantry Division (Mechanized), supported by the 21st Engineer Battalion, is conducting a deliberate attack. LTC Castle, commander of the 21st Engineers, begins to daydream as he watches the plan unfold on the digital display in his command vehicle. He is comparing today’s plan with one he executed 10 years before as a captain.

Circa 1996

The brigade was conducting a

deliberate attack followed by a pursuit. The initial penetration had gone well and the brigade was on the march. A Company, commanded by CPT Castle, was supporting one of the lead task forces. Two bridges were ahead, but one was only military load class (MLC) 50 and the other spanned a 20-meter gap. Bypasses of both bridges were not available. The plan called for an armored vehicle-launched bridge (AVLB) to replace the MLC 50 bridge and a medium-girder bridge (MGB) to replace the 20-meter bridge if it was damaged.

The AVLB. As usual, the enemy didn’t cooperate. He quickly disengaged and fell back to the far side of the first gap. The assault and obstacle platoon leader led the AVLB launcher forward. The platoon leader and the AVLB crew tried but could not keep up with the armored task force. The task force had to wait at the gap for the AVLB to catch up. Then they emplaced the bridge.

Since the M1 tanks exceeded the rated capacity of the bridge, crossings were caution crossings and the lieutenant

became a bridge inspector. Meanwhile, the enemy was busy developing a complex obstacle in the path of the brigade’s advance, using mine layers, ditching machines, and wire. The breach would be a difficult mission resembling “an orchestrated ballet of farm implements.”

Scouts quickly found the minefield, the wire, and the tank ditch. The lead task force organized to conduct an in-stride breach. The support team began to suppress the site, while artillery and tanks provided smoke. After the security was set, an M1 with a mine roller began the breach by moving forward. When the roller encountered a mine, the M1 stopped and backed out. A combat engineer vehicle (CEV), on one of its last missions before retirement, pulled a mine-clearing line charge (MICLIC) forward and fired it. Another M1 with a track-width mine plow proofed the lane created by the MICLIC and then moved aside. A squad of sappers in an M113 armored personnel carrier came forward to breach the wire. The M113 moved aside, and an armored combat earthmover (ACE) attacked the tank ditch. Meanwhile, the support force

was rapidly running out of direct-fire ammunition. Artillery continued to fire, but the fight was beginning to take its toll on the support force. The task force commander tried to see through the smoke to determine the progress of the various parts of the ballet. After the ACE cleared the tank ditch, the assault force began to pour through the obstacle. It hadn't been pretty, but good training and hard work got the task force through in true ESSAYONS spirit.

The MGB. CPT Castle hoped the toughest part of his day was over, but it wasn't. The lead team radioed back that the 20-meter bridge was out. CPT Castle had planned for this eventuality, but the MGB company was still a few hours away. When the company arrived, the soldiers did their best, but the enemy rained artillery fire on the unprotected combat engineers building the bridge. They successfully completed the bridge but not without the loss of blood of some of the builders. The task force that followed CPT Castle passed lines, giving A Company a well-deserved rest.

Circa 2006

LTC Castle's thoughts returned to the present. Conditions certainly had improved in the last 10 years. Although the mission today was nearly identical, the ease and speed of execution were much different.

The MLC 50 bridge was not a problem. The Wolverines in his battalion could easily maintain the pace of the armored task force. Better yet, lieutenants did not have to be dedicated to keep track of them. The Wolverine was fully digitized. Not only did the crew get the same directional information as the Bradley and Abrams crews, but the engineer and maneuver force leaders could track their progress on digital map screens without any effort by the crew. The Wolverine made it to the site, received a digital command to emplace the bridge, laid the bridge, and sent a digital report that caused the bridge to show up on the task force's digital maps.

The complex obstacle was much easier to breach, too. The Grizzlies were already task organized with the breach force. The support force set the necessary conditions for the breach and then digitally tasked the A Company commander to send the Grizzlies into action. With a few keystrokes, the company commander ordered the mission. The Grizzlies moved forward, plowed through the minefield, and breached the wire with their blades. Meanwhile, the task force commander was receiving real-time feedback on his screen on the location and progress of the breach. After a Grizzly attacked the tank ditch with its arm, the breach site was shown on digital maps throughout the task force. Quickly, the task force was through the complex obstacle and on the move again.

The 20-meter gap was not a problem because the Wolverines traveling with the lead task force were easily able to bridge the gap and pass the task force. Using the under-armor launch capability and the short 5-minute launch time, the crew and task force had minimal exposure at the gap.

This scenario may sound like a pipe dream from the Engineer School, but it isn't. Both the Grizzly and the Wolverine are in development with operational prototypes undergoing testing. When

fielded, these two systems will accomplish complex obstacle breaches similar to the one that required CPT Castle to synchronize the use of many different systems. The first Wolverine will be fielded in 2000 and the first Grizzly in 2003. Both of them will be fielded to heavy division and corps mechanized battalions with a basis of issue of four Grizzlies and four Wolverines per company. These systems will greatly increase combat engineers' ability to provide responsive mobility support to Force XXI.

The Grizzly: A Heavy Force Complex Obstacle Breacher

The Grizzly is designed to breach simple and complex obstacles (see chart below). Mounted on a modified M1 chassis, the Grizzly features a mine-clearing blade equipped with an automatic depth control. It can clear mines at speeds up to 3 mph. The blade also cuts wire obstacles. It is complemented by an excavating arm that can attack antitank ditches, log cribs, and rubble. The system is required to clear a standard antitank ditch in 5 minutes or less.

The Grizzly will be a fully digitized member of the Army of the 21st century with a situational awareness similar to that of the supported M1 tanks

Grizzly Characteristics and Capabilities

- M1 Abrams chassis
- Full-width (V-shaped) mine-clearing blade with automatic depth control
- Power-driven arm for digging, grappling, and lifting
- Commander's control station with communications, enhanced vision devices, and area suppression weapons
- Mobility/survivability equivalent to the supported force
- Requires a two-man crew
- Breaches antitank ditches and minefields
- Clears urban rubble
- Initial system clears mines to 12 inches in depth at 3 mph
- Objective system will clear mines to 16 inches in depth at 4.5 mph

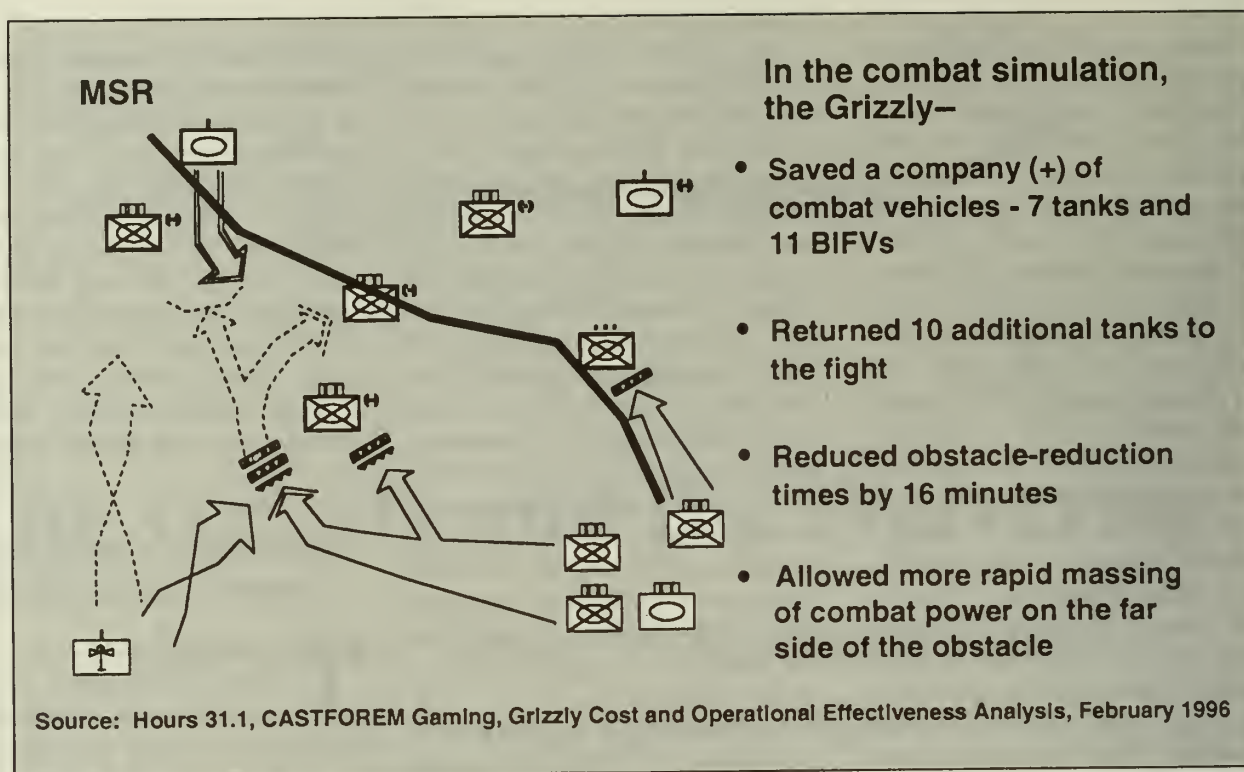


Figure 1. Grizzly Combat Effectiveness

and M2 Bradley fighting vehicles. The Grizzly promises to provide the maneuver task force with a robust, survivable, and mobile breaching platform to use against wire, mines, tank ditches, and log cribs.

The Grizzly's utility was highlighted by simulation results comparing it—operating alone—to the numerous systems we use today. The simulated



mission involved a brigade clearing a main supply route (MSR) (Figure 1).

Using the Grizzly in this battle had a stunning impact. The main attack encountered a complex obstacle with mines, wire, and a tank ditch. The Grizzly breached this complex obstacle 16 minutes faster than the currently used equipment. As a result, the task force was able to mass combat power on the

Analysis Domains	Current Situation: <i>ACE, AVLB, MICLIC/M113, M1 with Roller</i>	Future Situation: <i>Grizzly</i>
Doctrine	- Complex obstacles require a deliberate breach	- Grizzly breaches in stride
Training	- Requires complex obstacle-reduction training	- Requires single-vehicle training
Leader Development	- Planning and execution difficult	- Focused command, control, and communications
Organization	- Slow momentum of attack	- 2 Grizzlies
Materiel	- Combinations of AVLBs, M113s with MICLIC, and M1 Tanks	- Compatible with M1 fleet
Soldiers	- Incompatible with M1 fleet	- Reduced exposure time and M1 survivability yields fewer casualties
	- Low-density systems	
	- Casualties due to lack of armor and slow breaches	

Figure 2. Analysis of Grizzly's Impacts on Engineer Operations.

Wolverine Characteristics and Capabilities

- MLC 70
- Carried on an M1 Abrams chassis
- Mobility and survivability equivalent to the supported force
- Spans gaps up to 24 meters
- Requires a two-man crew

far side of the obstacle in less time, which saved a company (+) of combat vehicles. In addition, the Grizzly allowed 10 tanks equipped with breaching equipment (rollers and plows) to return to the fight rather than be committed to breaching duties. The simulation results make a strong case for the Grizzly requirement.

The Grizzly will also have a dramatic impact on engineer doctrine, training, leader development, organization, materiel, and soldiers (DTLOMS) as shown in Figure 2.

Using the Grizzly—instead of the M1 with roller and track-width mine plow, the MICLIC, the ACE, and the AVLB—will greatly simplify our doctrine, training, and planning and execution of complex obstacle breaches. The Grizzly should ease the logistics burden by replacing engineer-unique platforms with the common M1 chassis. Finally, soldier survivability for both the supported task force and the engineer force will increase due to the Grizzly's faster breach times.

The Wolverine: A Heavy Force Assault Bridge

The Wolverine is a heavy assault bridge designed to replace the AVLB on a one-for-one basis. It offers a substantial upgrade in capabilities compared to the AVLB. The Wolverine provides for a normal crossing of an MLC 70 vehicle over a 24-meter gap (see chart at left). The increased gap-crossing capability will allow the maneuver force to conduct assault breaches over gaps that require bridging to support lines of communications (Figure 3).

The Wolverine features a horizontally launched bridge, which offers a much lower profile than the vertically launched AVLB. Survivability of the force is enhanced and their momentum is maintained by the short 5-minute launch time and a 10-minute retrieval time. The Wolverine also provides the capability for launch from under armor, further increasing crew survivability. The Wolverine has a dual-purpose spade that stabilizes the chassis during launch and provides the crew a means

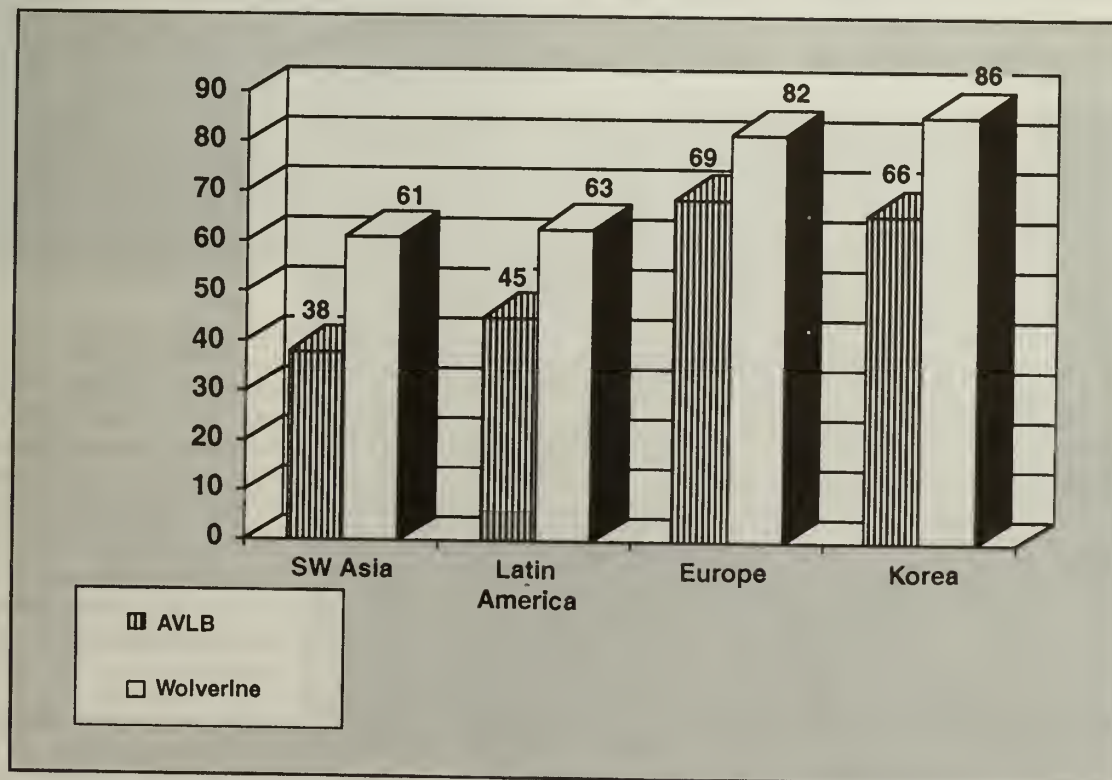


Figure 3. Analysis of Gap-crossing Capabilities of the AVLB and Wolverine for MLC-70. (Percent of Gaps Bridged)

Analysis Domains	Current Situation: AVLB	Future Situation: Wolverine
Doctrine	- Spans gaps to 15 meters; MGB spans gaps 15 to 24 meters - Travels at one-third the M1 speed (12 mph cross country)	- Spans gaps to 24 meters - Travels at M1 speed (35 mph cross country)
Training	- Requires three weeks for all systems	- Requires three weeks - Decreased costs using a combination of system and simulation training
Leader Development	- Planning and execution difficult for gaps greater than 15 meters: - Security - Fixed bridging assets - Command, control, and communications complicated	- Spans gaps up to 24 meters in less than 5 minutes
Organization	- Gaps less than 15 meters = 1 ALVB crew - Gaps 15 to 24 meters = 1 MGB platoon	- Gaps up to 24 meters = 1 Wolverine crew
Materiel	- Incompatible with current M1 fleet	- Compatible with current M1 fleet
Soldiers	- Crews suffer fatigue - Less survivable than the M1	- Reduced crew fatigue - As survivable as the M1

Figure 4. Analysis of Wolverine's Impacts on Engineer Operations.

of cleaning mud and snow off the bridge before retrieval.

Wolverine production will occur in conjunction with that of the M1A2 Systems Enhancement Package. By using the same production line as the

newest tank, the Wolverine will have the same embedded digitization package as that provided to the tank and infantry fighting vehicle fleet. The Wolverine will have armor protection and mobility similar to that of the

tank fleet (Figure 4). In the near future, the Wolverine will provide the Army with the world's premier assault bridge, one capable of providing responsive bridging support to the maneuver force of the 21st century.

Photo courtesy General Dynamics Land Systems Division.



Wolverine preparing to launch.

¹ Description of engineer breaching operations by BG Scott Wallace, Commander, National Training Center, to BG Phillip R. Anderson, Deputy Commanding General, U.S. Army Engineer School, 16 April 1996.

Major Greene is chief of the Combat Mobility Division, TRA-DOC System Manager, Engineer Combat Systems, U.S. Army Engineer School. He is a graduate of the Command and General Staff Officer Course. Major Greene holds a doctorate in engineering from the University of Southern California and is a registered professional engineer in Virginia.

Grizzly logo courtesy of United Defense Limited Partners.

Photo-Essay From Operation Joint Endeavor

By Major Andrew Goetz

The following photo-essay concerns the author's experiences in Bosnia during the period March to May 1996. It will be published in two parts, with this portion including an overview and information about force protection, mine clearing, and mine-dog teams. The fall issue of Engineer will include a discussion on base camps, the engineer construction effort, and heavy division engineer shortfalls. The photographs were taken by Major Goetz and the combat camera crews attached to Task Force Eagle.

Overview

I was assigned as an engineer observer with Combined Arms Assessment Team (CAAT) II, Center for Army Lessons Learned (CALL), Operation Joint Endeavor, in Bosnia. The CALL operates out of Tuzla, with an office in the division tactical operations center. Observers go out for several days at a time to visit units, then return to Tuzla to write observations and push them through the lengthy approval process. My brief two months in Bosnia did not make me an expert but did give me an opportunity to get a snapshot of engineer operations there. This "briefing" is based on events I personally observed in Task Force Eagle and the 1st Armored Division Engineer Brigade. It provides an overview of engineer operations in Bosnia-Herzegovina, not a discussion on the political or military situation.

Observations and lessons learned concerning events in Bosnia are available through the Center for Army Lessons Learned at Fort Leavenworth, Kansas, and through the Center for Engineer Lessons Learned at Fort Leonard Wood, Missouri.



Force Protection

Force protection is a major consideration that requires extensive engineer planning for perimeter wire, bunkers, towers, lighting, and fighting positions. The engineer battalion manages all construction in the brigade combat team sectors. The mission of managing the staggering quantity of Class IV materials was given to the 1st Armored Division Engineer Brigade.

Photo (left)

Guard towers are a fixture at all base camps. They are constructed primarily by the vertical platoons of the 94th Engineer Battalion. Because of poor soil conditions, a stable surface must be created to set them on. Compacted gravel, sandbags, and wide timber bases solve the problem. The towers are constructed with double walls; sandbags fill the gap between the walls and cover the roof.

To ensure that the force protection structures are safe, engineers inspect every bunker and tower and post an inspection certificate on the facility. The task force engineer takes the certification process seriously and had several structures rebuilt that did not pass the quality-control check. The construction management section attached to the division engineers provides quality assurance.

Photo (right)

As the weather warmed, local citizens attempted to penetrate perimeter wire, apparently to steal material inside the base camps. To solve this problem, engineers placed tanglefoot wherever practical. In this photo, tanglefoot is placed between the inner and outer perimeter fences.

Perimeter lighting is used at some sites to keep locals out. Task Force Eagle wanted to light the entire perimeter of their base camp, but that was easier said than done. Power distribution for a large base camp requires up to 0000 wire, something even the prime power teams are not equipped to handle. Because portable light sets are too expensive for the entire perimeter lighting mission, most perimeters are not lit. Part of the challenge in figuring out how to provide perimeter lighting is determining what the commander wants. For example, is the desired effect to enhance night vision capability, illuminate wire, illuminate grazing fire, or prevent people from seeing inside the perimeter?





Photo (left)

Existing buildings at Tuzla Main are used for a wide range of purposes. This building is similar to many that are used as barracks. The double-decker hootches the U.N. constructed in the open bays are being removed because they pose a fire hazard. Fixed facilities at the old Yugoslavian air base are used for Task Force Eagle headquarters, the mess hall, and unit headquarters.



Photo (above)

Hesco Bastions are used as helicopter revetments at Comanche Base, Tuzla Main.



Mine Clearing in the Zone of Separation

One of the divisional engineer brigade's missions is to supervise the "demilitarization of the zone of separation (ZOS)." This includes blowing bunkers, filling trench lines, and clearing minefields. The former warring factions are primarily responsible for completing this work, but U.S. engineers provide supervision to ensure that the work is done. The U.S. engineers do some tasks themselves, such as destroying bunkers. This series of photos is from a mine-clearing mission performed by Serbian engineers and supervised by 1st Platoon, A Company, 40th Engineer Battalion.

Photo (left)

On this day, 1st Squad and 1st Platoon—with an interpreter, a medic, and two Bradleys—linked up with the Serbian engineers—a lieutenant, two soldiers, and a driver—near the edge of the ZOS. We followed the Serb's truck to their trench line. When we reached a point where the road along the trench line was too muddy and steep to drive on, we dismounted and walked.



Photo (left)

The trench line runs along a crest. The Serbs led the way to the minefields we were to clear, which were about 2 kilometers from the dismount point. The platoon leader was very "situationally aware" of the mine threat. He knew that this section of trench line had never been occupied by anyone except the Serbs, so the mine threat on their side of the trench line was very low. On the far side, however, the threat was very high. The platoon leader instructed his soldiers to stay on the Serbian side of the trench line.



Photo (above)

A series of bunkers along the ridge links with the trenches. Fighting positions are spaced randomly along the trench line. Some bunkers are very basic, while others are completely enclosed with doors and windows. Pits behind the trench appear to have once held mortar and/or small-caliber artillery. The positions look across a large valley to the Muslim side of the line. At this point the Muslim trench line is several kilometers away; at other points it is as close as 30 meters.



Photo (above)

Minefields were recorded on Serbian mine data sheets, which show the location of the minefields, how many mines they contain, and whether any of them were detonated during the war. Here, the Serbian lieutenant and the 1st Platoon and 1st Squad leaders discuss the mine-clearing operation—how many minefields are here, how many will be cleared, and how the mines will be destroyed. The responsibility and coordination required to accomplish this mission are well above what we normally expect of a young platoon leader, much less a squad leader, but we ask them to do this type of mission every day.



Photo (left)

This Serbian mine-marking sign is written in Cyrillic. Part of the Dayton Accord requires the former warring factions to mark their minefields with a barbed-wire fence on all four sides. The Serbs frequently do not do this and can't be convinced it is necessary. First, there aren't enough Serbs to carry the marking materials to minefields in remote locations such as this. Second, since they are taking mines out of the minefields, they don't see a need to mark them. Finally, they are hesitant to mark the Muslim sides of minefields because they don't know if the Muslims have mined them.



Photo (left)

After reviewing the mine data sheets, this Serbian mine-clearing team went in front of the trenches to look for mines. When they found the PMR-2A mines, they cut the wire, pulled the mines out of the ground, and threw them up the hill to the Serbian lieutenant. They wore no protective armor and were very casual about the whole thing.

Photo (right)

Here, a batch of mines is rigged for demolitions. The mines were destroyed on-site by Serbian engineers. At this time, the Serbs were required to provide their own demolitions. Later Task Force Eagle allowed U.S. engineers to provide demolitions if the factions could not.

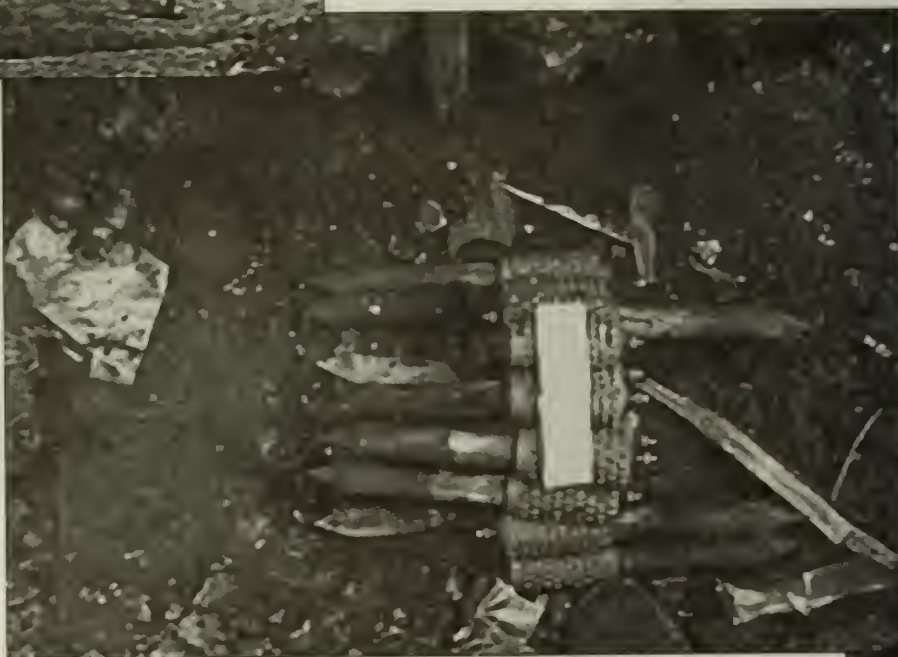


Photo (below)

On the first attempt to destroy the mines, the blasting cap fell out of the plastic explosives, causing a misfire. The platoon leader wanted the Serbs to wait 30 minutes before approaching the rigged mines but could convince them to wait only 15 minutes. The Serbian lieutenant then checked the demolitions, re-rigged them, and successfully destroyed the mines.



Photo (right)

At the end of the day, the Serbian lieutenant and the 1st Platoon and 1st Squad leaders reconciled the number of mines removed with the number shown on the mine data sheets. The sheets showed that 41 mines were originally placed in this sector. Seven of them were destroyed during the war. A Serbian engineer said that eight more mines were installed but not recorded on the data sheets. A total of 42 PRM-2A mines were removed from the sector on this day. The numbers conveniently added up, but it is impossible to determine if they are correct. This is why all minefields are considered active even though they have been "cleared."



Mine-Dog Teams

Both the Swedes and the Russians have mine dogs in theater, and in April 1996, our military police certified five mine dogs for use in Bosnia. They are the only mine dogs in the U.S. Army. These photos were taken at a mine-dog training site outside of Tuzla. The buried mines have been defuzed.

Photo (left)

This dog has located a buried mine, and the handler marked it with a mine bonnet. The team is now looking for a bypass. The second soldier marked the lane using a can of blue spray paint secured in long-handled holders. The lane marker sprays on both sides of the dog handler's boots. We should consider using this system for marking assault foot lanes through cleared minefields. (Utility companies use similar paint can holders to mark underground cables and pipes.)



Photo (above, right)

Here, the mine-dog team clears around a "casualty," and one soldier marks the cleared area with paint. After a lane to the casualty is cleared and the clearing team is out of the minefield, the rescue team moves along the lane to recover the casualty. The dog identified the mine next to the casualty; it is marked by a mine bonnet.



Photo (far right)

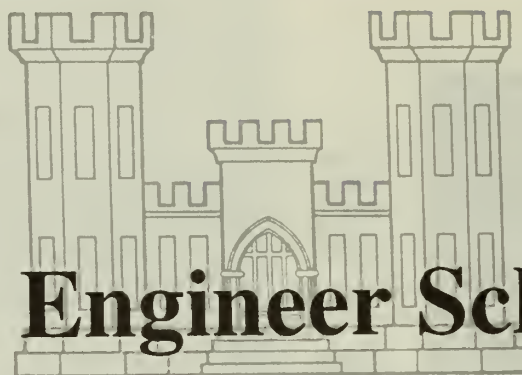
This U.S. mine-clearing dog is allowed to go forward on a long leash up to 20 feet in front of the handler. (The Swedish team keeps their dogs on very short leashes.) The second soldier marks the lane with engineer tape that is staked at the entrance to the lane and dragged along with the team. This is not a very effective system. In fact, if the training lane was not marked and the engineer tape already staked out, the team would not have used it. This dog successfully located the buried mines in the training lane.

Conclusion

I hope that this photo-essay helps you appreciate the vast scope of ongoing engineer operations in Bosnia-Herzegovina. The experience gained from this mission is producing skilled, confident young engineer leaders for tomorrow's Army.



Major Goetz is currently attending the Command and General Staff College at Fort Leavenworth. Previous assignments include construction branch chief, U.S. Army Engineer School, Fort Leonard Wood, Missouri; company commander, 82d Engineer Battalion, during Desert Storm; maintenance detachment commander, 3rd Engineer Brigade, 3rd Infantry Division; and military observer to the U.N. mission in the western Sahara.



The Engineer School:

Providing Lessons Learned to the Force

By Major David Brinkley

The U.S. Army Engineer School established a Lessons Learned Branch in the Department of Training and Doctrine in May 1995 to gather engineer lessons from ongoing operations and disseminate them to the field. The Lessons Learned Branch replaces a function formerly filled by the Directorate of Evaluation and Standardization, which was disbanded in 1995. This article highlights the critical mission of the Lessons Learned Branch within the engineer community by examining a few significant lessons gathered to date from Operation Joint Endeavor in Bosnia. The branch is tasked by MG Gill, Commandant, to gather information in three key areas: countermine operations, bridging, and sustainment engineering.

Countermine Operations

The Engineer School's involvement with countermine operations focuses on mine-awareness training and the collection of countermine lessons learned. Early in Operation Joint Endeavor, school personnel became heavily involved with mine-awareness training for units deploying to Bosnia. The Doctrine Development Division and the Department of Tactics, Leadership and Engineering jointly developed a comprehensive training program designed to "train the trainer." First we examined the existing doctrine, which was found to be sound.

"Operation Joint Endeavor is a veritable gold mine of engineer lessons learned."

Then we used FM 20-32, *Mine Countermine Operations*; FM 90-13-1, *Combined Arms Breaching*; and *The Engineer Contingency Handbook* to develop tactics, techniques, and procedures for the training program.

LESSON LEARNED: *The doctrine used for high-intensity conflicts is sound and flexible enough to be useful in contingency operations. However, special publications, such as the Engineer Contingency Handbook, are required for some areas of operations.*

The comprehensive training program was developed for the 16th Engineer Battalion, 130th Engineer Brigade. The training is based on doctrine for high-intensity conflicts and modified based on the situation in Bosnia. This training is intended for all soldiers. It focuses on the avoidance of minefields and unexploded ordnance (UXO) and extraction from minefields. The training is required for all civilian and military personnel deploying to Bosnia.

When the 16th Engineer Battalion was called to participate in Operation Joint Endeavor, the Engineer School assisted in training units deploying from the continental United States and the Southern European Task Force. A mobile training team from the school used the program to train deploying forces at Fort Bragg, North Carolina; Fort Riley, Kansas; and Vincenza, Italy. Their efforts reduced the backlog of units requiring predeployment training in USAREUR. The newly formed Countermine Training Support Center at the Engineer School continues to provide this type of service to the Army.

LESSON LEARNED: *Maintain jointly prepared countermine training plans as an "off-the-shelf" resource to facilitate the rapid development of mobile training teams. Regardless of the source, the Engineer School should collect and store these plans for use in future contingency operations.*

The Lessons Learned Branch is aggressively collecting data from the 1st Armored Division. Direct links with the division's Mine Action Center, the Center for Army Lessons Learned, and the combined arms assessment teams allow us to acquire emerging doctrinal trends and critical information. In return, we serve as adjunct staff for the 1st Armored Division Engineer Brigade to assist with research, data collection, and analysis. School personnel also work extensively with private industry

and Army laboratories to develop new countermine systems.

LESSON LEARNED: *Both Engineer School personnel and deployed engineer soldiers benefit from close communications before, during, and after a deployment.*

Bridging

The world watched in awe as U.S. Army engineers bridged the Sava River under dismal conditions last winter. Their heroic efforts established one of the longest float bridges ever built—and it's still crossing Implementation Force (IFOR) traffic today.

In Operation Joint Endeavor, engineers successfully executed the largest military bridging mission since Vietnam. To date, U.S. engineers in Bosnia have built nonstandard fixed bridges, assault float bridges, a medium girder bridge, Bailey bridges, and a commercially available British Compact 200 bridge. To quote Colonel Steve Hawkins, Commander of the 1st Armored Division Engineer Brigade, "U.S. engineers built a British bridge to support a Russian brigade." This diverse capability characterizes much of the bridging expertise in Bosnia today. Engineer soldiers also have laid more than 20 AVLBs in support of the 1st Armored Division and, using techniques seldom required in today's Army, are repairing a railroad and a railroad bridge.

The Engineer School routinely provides experts to assist in bridge construction and has reaped benefits from this tremendous bridging effort. School personnel have collected lessons from bridging operations in Bosnia and are incorporating them in the latest version of FM 90-13, *River Crossing Operations*.

LESSON LEARNED. *School and field personnel should work together to update and revise doctrine. Experience gained in Bosnia has provided key*

lessons we are using to revise FM 90-13-1 and FM 20-32.

Sustainment Engineering

Due to Bosnia's war-torn infrastructure, engineers in the 1st Armored Division are performing numerous construction missions to support the force. They continue to clear and repair mined and damaged roads. Housing, utilities, and water facilities are nonexistent or severely damaged almost everywhere and must be provided. All of this construction is accomplished through a combination of military troop construction, the Logistics Civil Augmentation Program (LOGCAP), and joint engineering.

Both Operation Joint Endeavor and Operation Uphold Democracy, in Haiti, have identified a serious deficiency—the lack of doctrine for joint engineer operations and combat heavy engineer operations. To meet this requirement, Engineer School personnel, in conjunction with the Army National Guard, will use the numerous lessons on infrastructure requirements, force protection, and joint engineering from these operations to write a capstone combat heavy engineer operations field manual. The school will also write a joint engineer capstone publication.

One concept that has emerged from Operation Joint Endeavor is *Force Provider*, a containerized base camp that allows rapid construction of long-term facilities. The Army organized Force Provider Companies in the Quartermaster Corps—Quartermaster personnel deliver a base camp as a commodity, and engineers assemble it. The camp sites require substantial preparation by engineers for site preparation, utility connections, and force protection. After a camp is assembled, the Quartermaster Company operates it and the associated facilities.

LOGCAP, another sustainment concept, is a tremendous force multiplier in Bosnia. It originated during Operation Desert Shield, when contractors were hired to perform most sustainment engi-

neering and facilities services for the Army. LOGCAP was formalized in Haiti and has come to maturity in Bosnia. Both LOGCAP and Force Provider are examples of emerging concepts that the Engineer School has "captured" for use in contingency operations.

LESSON LEARNED: *Joint and civilian engineers will be part of most, if not all, future military engineer operations. We must become knowledgeable about the construction capabilities and limitations of other services and civilian contractors and fully integrate them in future operations.*

Operation Joint Endeavor is a veritable gold mine of engineer lessons learned. We are using the opportunity Bosnia provides to test the ability of the Lesson's Learned Branch to collect, analyze, and disseminate lessons to the field in a timely manner. For example, recently we received a lesson concerning the AVLB from the 2nd Infantry Division Engineer Brigade, in Korea, and immediately passed it to engineers in Bosnia. Our wish is to continue to provide that kind of service to the Engineer Regiment.

We invite you to share information with us. Send your good ideas or lessons to Mr. Bill Blackwell, at blackwell@wood-vines.army.mil. We also encourage you to browse through the latest lessons learned and doctrine on the Fort Leonard Wood Internet Home Page, at <http://www.wood>.

LESSON LEARNED: *More than 25,000 people have used the Engineer Home Page service to date. Let us assist in your next training exercise or operation.*



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An Engineer Reconnaissance Platoon: A Proposal

By Major Douglas McNeese and Captain Steven Creighton

Too often during simulated combat, engineers must painstakingly "pull" critical information from maneuver channels, only to receive reports that lack important engineer-specific details regarding obstacles, enemy engineers, and terrain. To correct this shortfall, we propose that U.S. Army engineers implement a reconnaissance platoon that is organic to divisional engineer battalions.

The proposed platoon would consist of three engineer scout squads that could be either independently sliced to task force (TF) scout platoons or operate together as a brigade reconnaissance asset. In practice and by doctrine, TF engineers attach combat engineers to their TF scout platoons to enhance obstacle identification and terrain analysis. The engineer reconnaissance platoons would support this effort three ways:

- Provide tactically proficient engineers who are trained to operate forward of the forward edge of the battle area (FEBA).
- Promote habitual relationships between scout platoons and their engineers.
- Clearly define the role of engineer squads when they support scout platoons.

Current Engineer Reconnaissance: Practice and Doctrine

During most combat operations, combat engineers support scouts and provide technical expertise about terrain and obstacles—an asset usually welcomed by the scouts. However promising this arrangement may appear, the value added is usually minimal, and the shortcomings are no fault of the soldiers. Most combat engineers are not trained in scout tactics and thus lack the tactical expertise needed to integrate properly. Furthermore, no guidelines exist for engineers tasked to support scouts. Before we can expect top performance from our soldiers, we must determine—

- Who commands and controls the engineer scouts.
- If combat engineers should ride inside scout vehicles or operate their own.
- If habitual relationships between scouts and engineers are desirable.
- The tasks combat engineer scouts should focus on in offensive and defensive operations.

Maneuver doctrine describes the engineer augmentation of TF scouts in detail, but engineer doctrine on the issue is vague. For example, FM 17-98, *Scout Platoon*, page 6-32, states, "In reconnaissance operations, an engineer squad may be placed in direct support of a scout platoon." Six pages are dedicated to engineer capabilities and limitations and 32 pages in the appendix address obstacles. Similarly, FM 71-2, *The Tank and Mechanized Infantry Battalion Task Force*, page 3-47 (paragraph h), supports this by stating, "Elements of the supporting engineer unit are employed with the [scout platoon] to reconnoiter obstacles."

Unfortunately, the engineer response to these expectations is not strong. Both FM 5-71-100, *Division Engineer Combat Operations*, and FM 5-100, *Engineer Combat Operations*, repeatedly stress the importance of engineers in reconnaissance and the intelligence preparation of the battlefield (IPB) process, but they fail to address methods of employment and command and control. FM 5-100, page 44, states, "Engineers identify specific reconnaissance requirements and augment dismounted patrols and scouts to identify obstacle characteristics." It goes on to say, "During the attack, engineer reconnaissance teams and engineer units provide continuous surveillance along the routes of advance." Here, our doctrine clearly acknowledges the need to augment scouts and to establish engineer reconnaissance teams but says nothing more—leaving implementation a hodgepodge, makeshift element determined by the task force engineer.

Mission and Employment

The engineer reconnaissance platoon should have several intelligence-gathering missions, including:

- Terrain analysis.
- Determination of trafficability on proposed routes.
- Determination of soil suitability for digging.
- Route reconnaissance, road reconnaissance, and bridge classification.
- Reconnaissance of specific named areas of interest, targeted areas of interest, and decision points that may contain obstacles or be tied into obstacle plans.

- Identification of areas forward of the FEBA suitable for FASCAM minefields.
- Covert breaching and obstacle marking.
- Detailed reporting of enemy obstacles and overwatch positions.
- Identification of threat engineer equipment and capabilities.

Information on threat engineer capabilities assists commanders and planners in determining the enemy's main effort, forward security element, and flank; and in confirming assumptions made during the IPB and engineer battlefield assessment (EBA). Enemy minefield reports should include length of frontage, depth, orientation, density, composition, and bypass information. This detailed minefield information usually is not reported by TF scouts but is critical to engineers planning a breach.

Both scouts and engineers currently have too wide a spectrum of missions and tasks expected of them, which limits their ability to do any one mission well. For example, scouts are expected to be experts in all forms of reconnaissance, enemy identification, counterreconnaissance, and enemy obstacles. Similarly, combat engineers are expected to be experts in bridging, emplacement of friendly obstacles, enemy obstacles, and reconnaissance. The introduction of engineer recon units will produce more focused combat engineers and give both scouts and engineers a more attainable scope of mission requirements.

Equipment and Organization

The vehicles currently used in scout platoons are armored HMMWVs and off-road motorcycles. Of these, armored HMMWVs would best suit the engineer recon platoon. They are fast, maneuverable, quiet, and easily maintained; provide small arms protection; and have storage space and a turret. A recon squad might consist of eight men and two HMMWVs, with four soldiers per vehicle. Additional equipment for the squad may include an MK-19 grenade launcher, a .50 caliber machine gun, squad automatic weapons (SAW), AT-4s, AN-PSS 12 mine detectors, global positioning systems (GPS), SINCGARS radios, AN-PVS-7 night vision devices, hand-emplaced minefield-marking systems (HEMMS), VS-17 panels, demolition kits, and Polaroid cameras.

Command and Control

In a task force, the scout platoon serves as the commander's eyes and ears on the battlefield. The scout platoon leader takes orders and sends reports directly to the TF tactical operations center (TOC). Similarly, the engineer recon platoon leader should send reports directly to the engineer battalion TOC. This reporting procedure will provide brigade and TF engineers with direct links to engineer-specific intelligence forward of the FEBA. Currently, brigade

and TF engineers obtain that intelligence, often by pulling it secondhand through maneuver S2 channels or by finding it the hard way—such as running into an enemy mine.

Engineer recon squads should be tied into brigade and TF reconnaissance and surveillance plans and employed in one of three ways:

- Sliced out, with each squad supporting a scout platoon.
- As a platoon, working for the brigade engineer.
- As a mixture.

In the last two scenarios, forward employment of an engineer reconnaissance element will require special measures for resupply, presumably by the same element that resupplies the scouts.

Threat Engineer Reconnaissance

Engineer battalions in the former Soviet pact forces have used engineer recon platoons for many years. Their platoons provide squad-sized engineer recon patrols (ERPs) that colocate with division and regimental recon patrols. The ERPs send engineer-specific intelligence to a director of engineers at both regimental and division levels. Although the recon companies of motorized rifle regiments and tank regiments consist of motorcycles and BMP and BRM armored vehicles, the engineer recon platoons have BTR armored vehicles. The platoons also have DIM truck-mounted mine detectors and VHF radios.

Engineer Reconnaissance Training

Training combat engineers to be qualified engineer reconnaissance scouts would neither be difficult nor require an additional military occupational specialty or time away from Fort Leonard Wood. The following program proposal is austere because combat engineers often are *tactically* deficient not *technically* deficient when operating forward of the FEBA.

The long classroom hours spent in basic and advanced courses for engineer officers and NCOs (EOBC, EOAC, BNCOC, and ANCOC) have produced well-schooled leaders. However, training in tactics such as noise and light disciplines, stealth movement, breaking contact, and reporting is lacking. Unfortunately, on-the-job training often leads to "the untrained leading the untrained" and specialty training in the Ranger and Scout Platoon Leader Schools is mainly for officers. Moreover, the Sapper Leader Course at Fort Leonard Wood focuses on light operations. The following tiers would establish a sound training program for engineer scouts.

1. Increase instruction for officers in EOBC to include task force scout operations (how they are employed and how engineer recon squads can assist scouts with gathering intelligence). Continue to send lieutenants to the Scout Platoon Leader Course at Fort Knox after they graduate from EOBC,

and add a combat engineer reconnaissance course to Fort Leonard Wood's program of instruction.

2. Train NCOs at the proposed combat engineer reconnaissance course at Fort Leonard Wood. As a branch of the Sapper Leader Course, it would be similar to the Scout Platoon Leader Course but tailored for engineers.

3. Provide motivated basic trainees desiring to be scouts with additional advanced individual training immediately after graduation. This special module would teach the basics of enemy obstacle identification and reconnaissance. Upon arrival at their units, these soldiers would receive additional training from NCOs trained at the combat engineer reconnaissance course.

Meet the Challenge!

The potential benefits of adding a combat engineer reconnaissance unit to our force structure is apparent at all echelons. Engineer recon platoons would assist scouts in gathering intelligence and significantly increase the level of combat engineer expertise throughout the Corps. Why not provide highly trained engineer soldiers tailored to meet the challenge! Implementing this platoon would be relatively simple, and soldiers from squad leader to division engineer would benefit. Essayons!

Note: Since this article was written, the Experimental Force at Fort Hood has added a reconnaissance section to the engineer battalion headquarters as part of their organization. In addition, the Engineer School is currently writing FM 5-170, *Engineer Reconnaissance*, which will address many of the concerns in this article. The authors' concerns, however, are still valid and are provided to stimulate discussion.

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Captain Steven L. Creighton is commander of the 68th Engineer Company (CSE), Fort Hood, Texas. He previously served in the 1st Armored Division Assistant Division Engineer section during the IAD BCTP Warfighter exercise, Baumholder, Germany (February 1994). CPT Creighton is a graduate of the Engineer Officer Advanced Course and the Armor Scout Platoon Leader Course. He was a sapper platoon leader in the 40th Engineer Battalion (Baumholder, Germany) during numerous rotations at CMTC.

The ENGINEER Writer's Guide

We think engineers take a special pride in their profession, and *Engineer* is always looking for articles from readers who want to share their expertise, experience and ideas.

If you're a potential contributing writer, here are a few "writer's guide" tips to steer you in the right direction:

Articles may discuss engineer training, operations, doctrine, equipment, history, or other areas of general interest to an engineer readership.

We're especially interested in articles that have a "how-to-do-it-better" theme. For instance, we're not looking for articles telling readers how you conducted a routine field exercise. But if you think you have a "new-and-improved" way of conducting a tactical operation, training exercise, or other operational procedure that may prove helpful to other engineers—that's what we need.

Articles should generally come from contributors with firsthand experience with the subject being presented. Avoid theatrical writing styles like: "It was a dark and stormy night..." or "...the soldier blazed through the jungle on his lumbering D7, providing a trail of freedom for the other vehicles..."

Articles should be concise, straightforward, and in the active voice.

Length should range between 2,000 and 4,000 words and text should be typewritten and double-spaced. Generally, each such page will contain from 200 to 250 words. Provide a disc with the manuscript.

Articles containing attributable information or quotations not referenced in the story should carry appropriate footnotes.

Manuscripts must be original, unpublished, and not under consideration by another publication.

All submissions are subject to editing.

Contributors are encouraged to include black-and-white or color photos, artwork, and/or line diagrams that illustrate information in the article.

Include your full name, rank, current unit and job title. Also include a list of your past assignments, experience and education; your mailing address; and commercial daytime phone number. Send articles to: Editor, *Engineer Professional Bulletin*, ATTN: ATSE-TD-D-EB, Fort Leonard Wood, Missouri 65473-6650.

If you have questions about an article you're working on—or considering writing—call Cathy Eubanks or Shirley Bridges, at DSN 676-4104, or commercial (573)563-4104. We look forward to hearing from you.

Marine Engineers:

Construction and Destruction on Demand

By Captain Thomas Pratt

With fewer resources and more missions, joint operations are now a way of life. To ensure the optimum use of assets and mission success in joint operations, all service members must become familiar with the capabilities that other services bring to the fight. The Marine engineer brings a unique contribution to present-day joint operations—expeditionary engineering, which supports the Marine Air-Ground Task Force (MAGTF) in combat support and combat service support missions. This article presents the history of Marine engineering through its evolution as the Marine component of joint engineering.

History

In the late 1800's, the Marine Corps mission expanded as America's status as a world power grew. The new mission to seize and defend advanced naval bases required that Marines have their own construction, maintenance, facilities operation, and general service capabilities. As a result, the initial mission of Marine engineers was primarily combat service support. Their objective was to construct, repair, or improve facilities in amphibious operation areas.

World War I. During World War I, the Marines relied on the Army to provide what we now call combat engineer support. In 1927, the Commandant of the Marine Corps, Major General Lejeune, further enhanced the role of the Marine engineer by publishing his vision of an organization within the Marine division that would operate captured or newly constructed advanced bases until relieved by their Army or Navy counterparts. That vision remained the mission of Marine engineers until the end of the 1930s. Today, these duties are mostly associated with landing support activities.

The development and organization of the Fleet Marine Force in 1935 gave birth to the Marine Corps' first force engineer companies. Engineers within these companies relied heavily on the Army for doc-

trine, training, and equipment. For military engineer schooling, Marine officers went to Fort Belvoir, Virginia, where they learned to apply civilian engineer knowledge in a military environment. In 1941, the Marine Corps established the Marine Corps Engineer School at Quantico, Virginia. A year later, the school was moved to Camp Lejeune, North Carolina. At this time, there were 58 military occupational specialties (MOSs) in the engineer field.

World War II. When World War II began, the Marine Corps grew immensely. For the first time, it began to think in terms of brigades and divisions and, along with this, the need for larger service units. By 1942, the Corps decided that each division would have an organic engineer battalion and an organic pioneer battalion. Normally these battalions went ashore in the second assault wave and set up the landing beaches. After the initial assault wave, they off-loaded materials and personnel. (The pioneer battalions are now called landing support battalions.) Later in the war, engineer regiments were formed with an engineer battalion, a pioneer battalion, and a Navy Seabee battalion. Since there was no



Marines from the 9th ESB pour a footing at Camp Foster, Okinawa.



Marines from MWSS-273 construct a temporary shelter in Jubail, Saudi Arabia.

standard table of organization and equipment at this time, all units were task organized to meet the division commander's specific needs during the island-hopping campaigns. The Marine "combat engineers" originated during World War II.

Assault engineer companies, created to breach the beach obstacles commonly found in the Pacific islands, were attached to regimental landing teams. These companies provided direct support to maneuver elements during landings and normally reverted to engineer battalion control when the battalion headquarters landed. Then they filled a general-support role for the regimental combat teams.

Except for the assault companies, employment of the engineer battalion in a purely combat support role was not considered. As a result, no combat-oriented doctrine or training was specifically developed for engineers. To compensate for this lack of training, infantry units normally received their engineer assets well in advance and trained them on assault techniques. On several occasions, Marine engineers applied their unique skills and equipment in assaults. Often an engineer or pioneer battalion was thrust into the defensive perimeter to free up an infantry unit.

Post-World War II. By the end of the war, the number of Marine engineers had increased more than 6,000 percent. Inevitably, they were hit hard by the postwar drawdown. In the late 1940s, the Marine Corps began a series of restructuring and reduction analyses to adopt a peacetime posture. In 1947, pioneer battalions were renamed "shore party battalions" to more accurately reflect their mission. Many of the engineer MOSs for Marine officers and enlisted personnel

were combined or deleted. Between 1945 and 1950, the number of engineer MOSs dropped from 55 to 9; however, the number of missions did not drop. This led to a "jack of all trades" phenomena that portrays Marine engineering today.

Korean War. During the Korean War, Marine engineer efforts focused on the mobility and survivability of the force. Constructing and maintaining main supply routes and airfields, clearing roads, and constructing bridges were common operations. Engineers also performed specialized demolition missions to disrupt the North Korean lines of communications. No significant changes occurred in the engineer community during the conflict, but it became evident that new, more advanced equipment was needed to perform their missions.

Post-Korean War. After the Korean War, the entire mission and structure of the Marine Corps was evaluated against the new threat—nuclear weapons. The popular thought at the time was that technology was becoming a more valuable resource than people. The engineer community did not suffer as badly as others, but significant changes occurred in the following years. The Navy Seabees were removed from the Marine engineer organization during the 1950s, although a strong link remained between the two services. To fill this void, a memorandum of understanding was written, and force engineer battalions were created.

The force engineer units had their roots in the aviation engineer battalions of World War II. Their mission was to support the entire landing force, including the aviation element, and to reinforce, augment, and expand the missions of

the division engineers. Therefore, the force engineer units were larger and more heavily equipped than the division engineer units. Bridge companies that were independent of both division and force engineers were created.

Vietnam War. In 1965, the U.S. military buildup in Vietnam began in earnest. The engineer effort there primarily involved humanitarian assistance. However, Marine engineers provided direct support in the actual fight, participating in practically every combat operation, search-and-destroy mission, roughrider convoy, and fire base preparation. Typically the engineers were a small, task-organized team—seldom more than three to four men—attached to an infantry unit.

Post-Vietnam War. Since the end of the Vietnam War, the Marine engineer community has undergone significant changes. In 1976, the division engineer battalion was renamed “combat engineer battalion” to more accurately reflect the combat nature of its mission. Once again, the Marine Corps responded to a postwar drawdown by restructuring the remaining active duty units. As a result, the force service support group (FSSG) was formed as the combat service support element of the MAGTF. Many of the division support units were moved into the newly created FSSG. The combat engineer battalion remained within the division, the force engineers were located in the FSSG, and the wing engineers were in Marine wing support squadrons (MWSS). When a MAGTF is organized, it pulls engineer assets from one or all of these three organizations, depending on the mission. This organization remains the same today. Because Marine Corps engineers lacked their own doctrine, they adopted the Army's doctrine when the FM 5-100 series was published in the mid-1980s. While the Marine Corps still uses Army doctrine, service-specific organizations are published in Fleet Marine Force Manual 13, *MAGTF Engineer Operations*.

Training

All Marine second lieutenants attend the Basic School at Quantico, where they are assigned an MOS. Assignments are based on their class standing, their staff platoon commander's evaluation, and their individual desires. Upon completion of the Basic School, lieutenants go to their respective MOS schools. Engineer officers attend a 13-week course at the Marine Corps Engineer School, where they learn the basic fundamentals that engineer platoon commanders need to know. However, engineer officers receive most of their training on the job. During fleet tours, engineer officers may be assigned to combat engineer battalions, engineer support battalions, or Marine wing support squadrons. Other assignments include the drill field, recruiting, facilities maintenance, Marine Corps headquarters, Marine Corps Engineer School, and professional and graduate studies.

Enlisted Marine Corps engineers are trained at several locations, depending on their specialty. They receive



8th Engineer Support Battalion Marines construct a “falling block obstacle” (MONOLITH) at Guantanamo Bay, Cuba.

entry-level training and then return for two career-progression courses at the noncommissioned officer and staff noncommissioned officer levels. Combat engineers receive demolition, bridging, vertical construction, and mine/countermine warfare training at the Marine Corps Engineer School. Marines in the utilities fields of electrician, electrical equipment, and hygiene equipment receive all training at the Marine Corps Engineer School. Engineer equipment operators, mechanics, and engineer assistants (drafting and surveying) receive all levels of training at Fort Leonard Wood, Missouri. Metal workers and refrigeration mechanics train at Aberdeen Proving Ground, Maryland. Bulk fuel specialists train at Fort Lee, Virginia. Enlisted engineers are assigned to Marine divisions, force service support groups, and Marine aircraft wings for duty. They may also become part of the inspector instructor staff at one of the reserve centers throughout the United States. Career enlisted Marines may receive assignments as drill instructors, recruiters, or Marine security guards.

Present Structure

The engineer mission is based on the way the Marine Corps fights—as a task-organized MAGTF consisting of four elements:

- Command element (CE)
- Ground combat element (GCE)

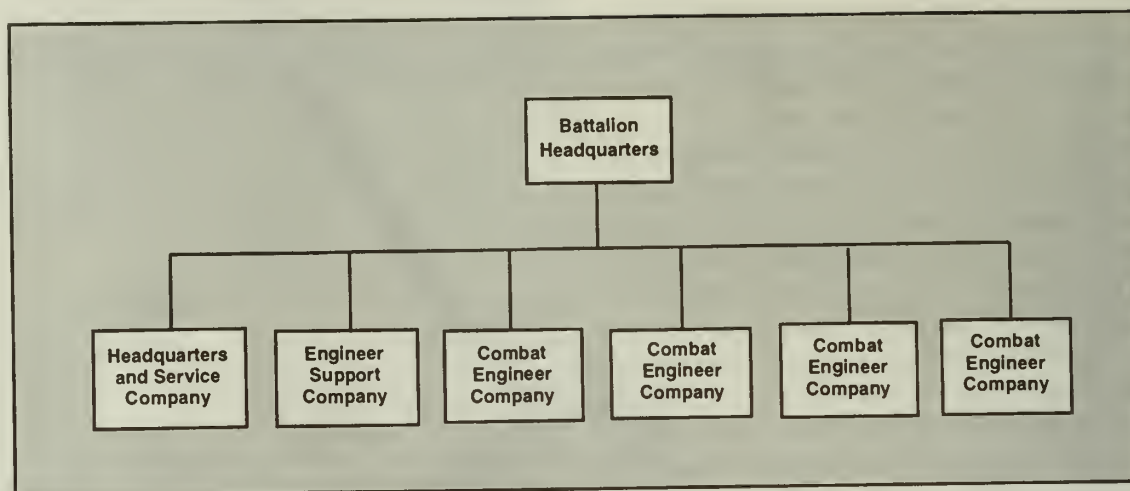


Figure 1. Marine Combat Engineer Battalion

- Aviation combat element (ACE)
- Combat service support element (CSSE)

If the mission dictates, Naval construction forces are attached to the MAGTF and become the fifth element. The Naval construction forces work directly for the MAGTF commander. Each element of the MAGTF has organic engineers. The Marine engineers' role is to support the MAGTF through operations in mobility, countermobility, survivability, and general engineering. However, Marine engineer support to the MAGTF is of an expeditionary nature and does not include the infrastructure building or theater-level construction provided by Naval construction forces and Army engineers. All engineer missions center on support to the MAGTF mission.

Command Element. The command element of a MAGTF includes the commander, the headquarters, and support required for command and control of the MAGTF. The MAGTF engineer serves as a special staff officer to the MAGTF commander. If the engineer position in the command element is not filled, the senior engineer in the MAGTF assumes the job as a secondary duty. The MAGTF engineer is responsible for coordination between the subordinate element engineer officers and, depending on the task organization and mission, Naval construction forces or other U.S., allied, or host-nation engineer assets.

Ground Combat Element. The ground combat element ranges in size from a battalion to one or more divisions. Engineers and their assets in the GCE are sourced from the combat engineer battalion (CEB) organic to the Marine division. The CEB consists of a headquarters and service company, an engineer support company, and four combat engineer companies (Figure 1). The size of the engineer complement varies with the size of the infantry unit to be supported. Normally a company supports a regiment, the platoons support the battalions in that regiment, and the company commander becomes the engineer staff officer for the regimental commander. The missions of the GCE engineers include:

- Performing engineer reconnaissance.
- Assault breaching of explosive and nonexplosive obstacles from the high-water mark inland.
- Employing assault bridge systems and, when augmented, other standard bridge systems.
- Repairing and reinforcing existing bridges.
- Constructing simple and compound explosive and nonexplosive obstacle systems.
- Performing demolition missions beyond the capability of other division units.

Additionally, Marines from the CEB provide mobile electric power to division organizations not authorized generators by their table of equipment and provide augmentation power to the division when required. Division engineers have limited resources in water purification and storage, field hygiene equipment, and vertical and horizontal construction. Division engineers primarily exist to support the maneuver of the ground combat element.

Aviation Combat Element. The structure of the aviation ground support is contingent upon the quantity and variety of aircraft to be supported. The ACE may vary in size from one aircraft squadron to one or more wings. Aircraft in the ACE are—

- Rotary-wing squadrons: UH-1N, AH-1W, CH-53D/E, and CH-46.
- Fixed-wing squadrons: F/A-18C/D Hornet, AV-8B Harrier, and C-130 Hercules.

The ACE may include one or all types of aircraft depending on the mission. Engineer assets organic to the ACE are located in four MWSS in the Marine wing support group. Two MWSS are dedicated to support fixed-wing aircraft and two are dedicated to rotary-wing aircraft (Figure 2, page 21). Normally, one MWSS is located in a Marine aircraft group. An MWSS detachment supports a composite squadron similar to those

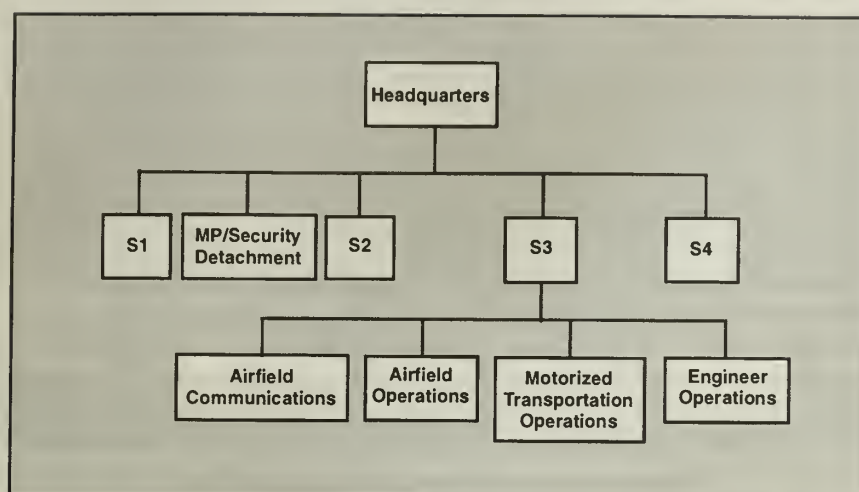


Figure 2. Marine Wing Support Squadron (V) or (R)

deployed with Marine expeditionary units (MEUs).

Wing engineers provide the ACE with limited vertical and horizontal construction capabilities. Airfield construction by elements of the MWSS normally is limited to 900 feet or less. Except for construction of forward area arming and refueling points, total engineer effort is focused on maintaining existing airfields rather than building new ones. When engineer requirements exceed the capabilities of the ACE, additional support may be obtained from the engineer support battalions and/or Naval construction forces. Wing engineer missions include:

- Performing engineer reconnaissance and survey.
- Repairing, improving, and maintaining existing road nets in the ACE tactical area of responsibility.
- Constructing and maintaining expeditionary roads.
- Constructing, maintaining, and improving vertical/short takeoff and landing sites.
- Constructing and maintaining mission-essential base camp requirements (temporary bunkers, aircraft revetments, and strongbacks).
- Providing essential utilities support (mobile electric power, water, potable water production, shower and laundry facilities, and refrigeration services).
- Developing, improving, and maintaining drainage systems.
- Assessing bomb damage and providing rapid runway repair.
- Supporting base material-handling operations.

Additionally, engineers are the bulk fuel commodity managers. They not only receive, handle, store, and operate bulk fuel assets during airfield operations but also set up expedient refueling systems at expeditionary airfields and

helicopter landing zones. They are capable of all testing required for fixed-wing and rotary-wing fuels. Explosive ordnance disposal assets are located in the wing to support rapid runway repair and base recovery after attack missions.

Combat Service Support Element. The combat service support element of a MAGTF ranges in size from a small, task-organized combat service support detachment to one or more force service support groups. The CSSE draws its engineers from the engineer support battalion (ESB) organic to the force service support groups. The ESB provides expeditionary general engineering support and engineer combat service support to the MAGTF. An ESB consists of a bulk fuel company, a headquarters and service company, an engineer support company, a bridge company, and three engineer line companies (Figure 3, page 22). The bulk fuel company receives, stores, and dispenses all Class III bulk fuel products for the Marine expeditionary force. Responsibility for the fuel begins when it crosses the shoreline. The engineer support company holds the battalion motor transport, utilities, maintenance, and earth-moving and material-handling assets. Platoons and companies deploying or training receive attachments from the support company as the mission dictates. Combat engineers are located in the engineer line companies.

The missions of the engineer support battalion include:

- Performing engineer reconnaissance.
- Performing deliberate vertical and horizontal construction.
- Providing utilities support to the MAGTF to augment its organic capability.
- Performing demolition and obstacle removal.
- Receiving, storing, and dispensing Class III bulk fuel.
- Performing countermobility and survivability tasks during defensive operations.

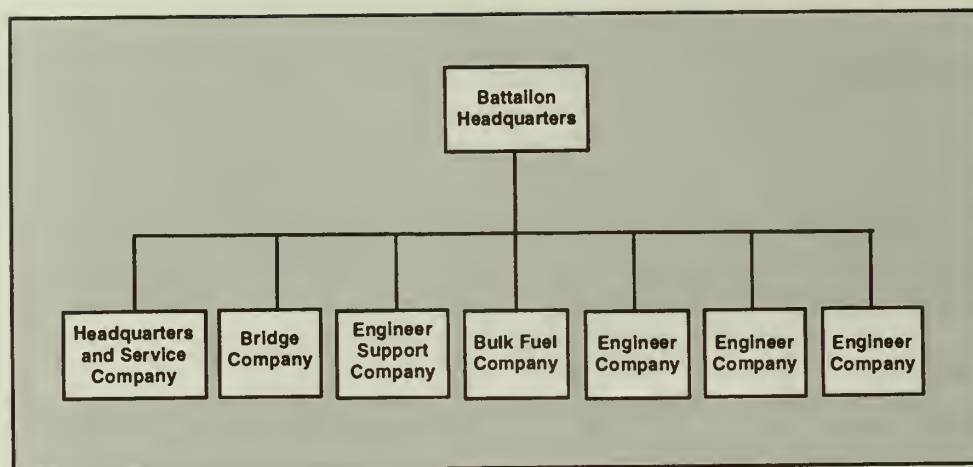


Figure 3. Marine Engineer Support Battalion

- Performing beach preparation and throughput to augment the landing force shore party.
- Reinforcing combat engineer battalions.
- Employing standard and nonstandard bridging.

Explosive ordinance disposal is also located with and managed by the engineer support battalions. However, it is a MAGTF asset and all taskings come from the command element.

Task Organizing a MAGTF. Task organizing for deployment is essentially the same for all MAGTFs smaller than a Marine expeditionary force. Typically, a Marine expeditionary unit is used. Engineers in the ground combat element are sourced from the combat engineer battalion. Engineers in the aviation combat element are from the MWSS engineer operations section, while those in the combat service support element come from the ESB. Each element's engineer section reflects the parent battalion. Often, the parent engineer battalion cannot fill their quotas for the MAGTF due to other operational commitments or shortfalls in staffing. Engineers from the landing support battalion, the maintenance battalion, and the medical battalion can be sourced to fill these quotas.

Recent and Current Operations

Marine engineers deploy year-round. They are found in every MAGTF and participate in every major Marine Corps exercise. Engineers most commonly deploy with a Marine expeditionary unit, as occurred in recent deployment operations to Lebanon, Grenada, Panama, Somalia, and Haiti. In Southwest Asia, Marine engineers played a tremendous role in the survivability, sustainability, and maneuverability of the MAGTF. Recent humanitarian assistance operations have taken engineers to places like the Philippines and Bangladesh to assist in recovery from natural disasters. In 1995, Marines from the 9th Engineer Support Battalion deployed to Sasebo, Japan, to relieve the drought-

stricken Navy base. Marines from the East Coast assisted efforts during hurricane relief missions in Florida. Currently, engineers are deployed with three Marine expeditionary units. Other engineers are in Aviano, Italy, in support of the mission in Bosnia, while some are participating in training exercises.

Looking Forward

Every day there is something new that threatens to divert money, resources, and people away from our services. Many feel that each service must protect its own, or soon there will be nothing left to protect. We must overcome this fear and embrace the future of joint operations. Each service possesses skills and equipment that are decidedly unique. Awareness of the capabilities of each service and the proper use of these capabilities in a joint environment ultimately will save our nation's military engineers.

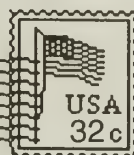
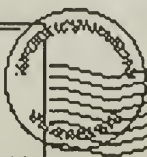
Captain Pratt is the engineer doctrine officer at the Marine Corps Combat Development Command, Quantico, Virginia. Previous assignments include Commander, Engineer Detachment, Marine Expeditionary Unit, Okinawa, Japan; and Commander, Alpha and Bravo Companies, 9th Engineer Support Battalion, Okinawa, Japan.

Reference:

Grelson, Captain J.D., USMC. "Up Front: The Evolution of the Marine Engineer," an unpublished research paper, 1987-88.

Note: This is the last in a series of articles on engineers of other services. See also "Navy Seabees and the Civil Engineer Corps: Providing Skills to the Joint Environment," Engineer, December 1994, pages 11-17; and "Air Force Civil Engineers: Building Air Power's Foundation," Engineer, August 1995, pages 30-35.

Letters to the Editor



Techniques and Procedures for Route Clearance

I am the company commander of C/16 EN and have been in the former Republic of Yugoslavia since 27 December 1995. My battalion and company have spent many weeks clearing routes through the ZOS [zone of separation] and clearing bunkers and trenches with the former warring factions. I have worked with Mr. Green in theater and feel that the article he and Mr. Schneck wrote is informative and reflects many of the lessons learned that engineer units here in Bosnia have sent to the rear. [Engineer, March 1996, pages 3-10.] However, I take issue with the second survivability technique listed in Table 3 on page 9. The technique is a means of escape from a vehicular mine strike.

The article suggests survivors "dis-mount onto the road. Do not move onto the shoulders without first looking for AP mines." This suggestion will get people killed. The former warring factions often protect buried AT mines with a triangular pattern of buried AP mines surrounding each mine. Stepping out of a damaged vehicle is not advisable unless one is in ambush and must move quickly.

The mine awareness training my company developed for V Corps prior to deployment teaches survivors to wait for extraction by personnel and equipment in following vehicles or engineers called to extract. A path from the vehicle to safety must be cleared of mines first. Self-extraction is possible if probing equipment and/or mine detectors are on hand.

I am concerned about others following the article's suggestion because it goes against our current training. One lieutenant in 3/4 CAV lost a foot when he stepped on an AP mine within 2 feet of an AT mine that had blown the track off a Bradley.

CPT Robert Floersheim
C/16 EN BN

Authors' reply:

We wish to thank CPT Floersheim for his input to our article and for suggesting an effective countermeasure. As always, the situation dictates. Combat engineers must always be alert to the nature of the threats they face and respond accordingly. When U.S. soldiers encountered the situation he described in Vietnam, it was sometimes necessary to evacuate critically wounded personnel requiring immediate medical attention from mine-damaged vehicles. This was accomplished by passing the wounded to the rear of the vehicle, dismounting onto the track left by the vehicle, and following that track out to safety.

William C. Schneck
Brian M. Green

Engineer School's reply:

If a unit drives into a minefield in Bosnia, the Engineer School recommends that the soldiers remain in their vehicle, report the situation, and wait for mine-clearing assistance, unless they are under fire. If immediate self-extraction is required, they should exit from the rear of the vehicle and carefully walk in the tracks the vehicle made entering the minefield.

Engineers in Bosnia: An Overview

I finally received the March 1996 issue of your magazine and saw a photo on page 19 that really troubles me. The caption reads, "An Abrams M1 tank, with mine roller attached, searches for mines in a field along Route Ostrich in the zone of separation. The field will be used for a joint military mission."

The picture troubles me for several

reasons. My main concern is with the soldiers in the picture. Two soldiers appear to be exposed from the waist up. Not only is this wrong because they should never expose that much of their bodies, it is especially wrong if they are searching for mines because, if they detonate a mine with the roller, it would instantly kill them. Another problem is that the cameraman is in front of the tank. Normally tanks clear forward, which would put the cameraman in the uncleared area. Unless he used a powerful zoom lens, the cameraman is probably in the blast radius of most antitank mines. That is not good for the life span of the cameraman. The entire magazine is devoted to mine awareness, which is probably a good idea. If that is the best picture we can find, we definitely need to greatly increase mine awareness in the region.

The only good point about the picture is that it is probably mislabeled. Although it is hazy, you can see where the belly of another tank had scraped the ground in the same place that the tank is going over, so he is not clearing the lane for the first time.

CPT Richard B. Stickers
C Company, 2nd Engineer Battalion

Author's reply:

I appreciate CPT Stickers' sharp eyes. The picture was downloaded from the Public Affairs Office net on the Internet, and the caption was included with the picture. This is clearly a "photo opportunity." The photo does not depict a tank actively proofing a field for mines. The crew may have backed the tank up along a previously proofed area to take a break. The 'belly scrape' marks in front of the tank indicate the area has already been proofed. For whatever reason, the crew was exposed because the tank was not moving when the photo was taken.

MAJ David Treleven

Transitioning the Technical Engineer (51T)

By Sergeant First Class Tony Arnold and Staff Sergeant Kevin Keefe



In September 1992, a Task Site Selection Board met to select critical tasks that would consolidate and streamline three military occupational specialties (MOSs): Materials Quality Specialist (51G), Technical Drafting Specialist (81B), and Construction Surveyor (82B). The board convened, voted, and released, and a new MOS—Technical Engineering Specialist (51T)—was born.

As with any new program, growing pains are to be expected, and the 51T MOS has experienced its share. Two problems identified by field personnel in both the active and reserve components are—

- How to train soldiers who held one of the three feeder MOSs and who have a Y2 identifier. The Y2 indicates that a soldier is not qualified in his/her current MOS.
- How to qualify soldiers who want to be reclassified into the new MOS.

Until recently there were no clear-cut procedures to accomplish either of these objectives. This article answers the questions concerning the removal of the Y2 identifier and qualifying the feeder MOS soldiers to 51T. Soldiers reclassifying into MOS 51T must follow guidelines outlined in AR 611-201, *Enlisted Career Management Fields and Military Occupational Specialties*.

Five options are available to remove the Y2 identifier from the 51T MOS:

- 51T Transition Training Course
- Active Component Basic NCO Course (BNCOC)
- On-the-job training program
- Civilian-acquired training/skills
- Wait until 30 June 97, when the identifier is withdrawn

51T Transition Training Course

The best option is the 51T Transition Training Course, which is taught at the Regional Training

Institute-North Dakota (RTI-ND) at Camp Grafton, home of the 5th Engineer Training Battalion. The course has two phases:

Phase I consists of 120 hours of instruction in soils, concrete, and conventional surveying. It runs for 2 weeks—7 days a week, 8.5 hours a day. The course includes Campbell Pacific MC-1 Nuclear Densimeter training and operator certification.

Phase II also consists of 120 hours of instruction—84 hours of automated surveying, using the Geodimeter 444 automated integrated survey instrument (AISI), and 36 hours of computer-aided design and drafting (CADD), using AutoCad LT and the theater construction management system (TCMS).

Additionally, RTI-ND will offer separate TCMS training once each quarter beginning in FY97.

The following courses from the Army Correspondence Course Program (ACCP) are prerequisites for Phase II:

- EN0591, *Surveying I*
- EN0592, *Surveying II*
- EN0594, *Surveying IV*

Soldiers who held the 81B or 82B MOS must attend both phases of the transition course to acquire the automation training. The Commander, RTI-ND may waive the ACCP subcourse requirement for the 82Bs. Soldiers who held the 51G MOS are exempt from Phase I but must attend Phase II. Completion of these requirements qualifies a soldier in the 51T MOS and removes the Y2 identifier.

51T Basic NCO Course

For qualified soldiers, the second option is to attend the active component BNCOC for MOS 51T. Upon successful completion of this course, the soldier's Y2 identifier will be withdrawn.

On-the-Job Training Program

The third option is an on-the-job training program. The only requirement is that the program be approved by the soldier's chain of command and the U.S. Army Engineer School's Directorate of Training and



A student performs automated drafting in the RTI-ND computer lab.

Doctrine (DOTD). This option was difficult to accomplish until the recent release of the Skill Levels 1 and 2 Soldier's Training Publication (STP) and Trainer's Guide (TG). This manual serves as a guide to develop the unit training plan.

To enroll a soldier in this program, the chain of command must submit a memorandum to the 51T senior training developer at DOTD. The memorandum should include:

- Tasks on which the soldier is to be trained.
- Tasks for which the soldier already meets the requirements (include all supporting documents).
- Estimated time needed to meet the requirements.

After DOTD approves the plan, it is returned to the requesting unit. When the soldier meets the requirements of the STP, the unit will submit the soldier's name and social security number to remove the Y2 identifier. With this method, several soldiers can be trained at the same time.

One drawback to the on-the-job training program is that it does not include certification with the Campbell Pacific MC-1 Nuclear Densometer. All soldiers must complete the required training for the MC-1, which currently must be conducted by a qualified instructor or operator.

In addition to the Transition Training Course, three options are available to personnel to meet the requirement for certification on the MC-1. The training plan should include one of the options listed below if the soldier has not attended the training previously. This certification is only required once during a soldier's career. An operator's certificate will be issued by the Engineer School or RTI-ND, and it is the only certificate authorized to represent validation as a certified operator on the MC-1.

- A mobile training team from the Engineer School or RTI-ND may be sent to the unit at the unit's expense. The unit must submit a request for training to the school or RTI-ND for this option.
- An interactive CD-ROM training course developed by the Engineer School will be available in late August 1996. This training must be conducted at the unit by a previously certified operator. No cost to the unit is anticipated.
- A 14-hour block of instruction conducted during the 51T10 course at Fort Leonard Wood. The unit must coordinate with the 1st Engineer Training Brigade at Fort Leonard Wood to attend this instruction.

Civilian-Acquired Training

The fourth option available for training personnel is civilian-acquired skills. Six credit hours of CADD training at a college or technical school meets the requirements for the drafting training. Materials testing training is available through the Corps of Engineers Waterways Experiment Station at Vicksburg, Mississippi. Survey training on the Geodimeter 444 is more difficult to obtain in the civilian sector. However, a new equipment training team contracted by the U.S. Army is providing the training to units Armywide. Soldiers who complete this training meet the STP requirements for tasks using the Geodimeter 444. Certification on the MC-1 must be completed as described in the OJT program.

Waiting Until June '97

Army Regulation 611-201 establishes the termination date for the Y2 identifier for MOS 51T as 30 June 1997.

Conclusion

While waiting for the termination date to remove the Y2 identifier from a soldier's MOS is an option, it is not recommended by the Engineer School. This method will not produce well-trained and motivated soldiers. A combination of the other options may be approved by the school and, in many cases, completion of these options will qualify a soldier for MOS reclassification. It is important for leaders to remember that whatever option(s) are chosen, prior coordination with the Engineer School will speed the process and streamline the approval process.

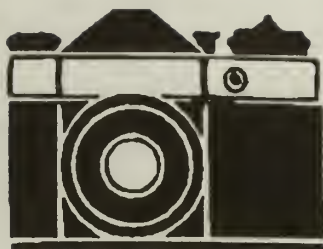
Address questions concerning the Transition Training Course to: Commander, Regional Training Institute-North Dakota, 5th Engineer Training Battalion, ATTN: SSG Kevin Keefe, RR 5, Box 278A, Devil's Lake, North Dakota 58237. SSG Keefe may be reached at (701) 662-0400 or DSN 344-5226, extension 400.

The point of contact concerning MC-1 Nuclear Densometer training at the 1st Engineer Training Brigade, Fort Leonard Wood, is Mr. Ron Winrich, (573) 596-5410.

For other information, contact SFC Walter Mortimer at (573) 596-0131, extension 37593, or DSN 676-7593; or SSG Tom Hylsky, (573) 596-0131, extension 37511, or DSN 676-7511.

SFC Arnold served as the 51T senior training developer at the U.S. Army Engineer School, Fort Leonard Wood, Missouri, from 1992 to 1996. Previous assignments include 51G senior instructor, Fort Belvoir, Virginia; combat construction NCO, 44th Engineer Battalion, Korea; technical engineer, 84th Engineer Battalion, Hawaii. He is a graduate of the 51T Basic NCO Course and the CMF 51 Advanced NCO Course and holds an associate degree in construction management from Park College, Parkville, Missouri.

SSG Keefe, the 51T NCOIC at the 5th Engineer Training Battalion, assisted in the design and development of the 51T Transition Course. Previous assignments include squad leader, B Company, 397th Engineer Battalion, LaCrosse, Wisconsin. SSG Keefe was an instructor for 51B10 and 51K10 Courses, Phase II of the 12 CMF Basic and Advanced NCO Courses, and Phase II of the 51H Basic NCO Course. He is a graduate of the 51T10 Advanced Individual Training Course.



Snapshots From a Liaison Officer

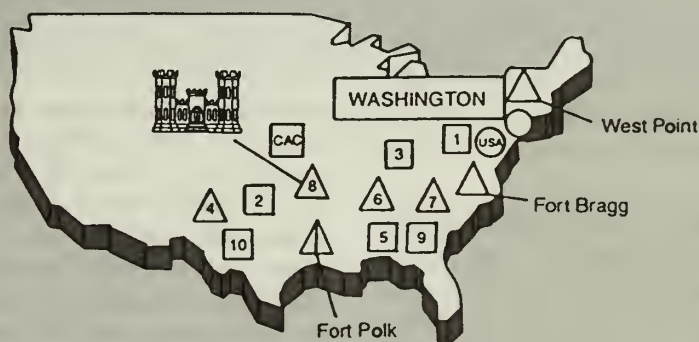
By Lieutenant Colonel Reinhold Hocke

Observations from the German Army Liaison Officer concerning the U.S. Army Corps of Engineers and his four-year tour at the U.S. Army Engineer School.

Throughout my military career, I have enjoyed many contacts with U.S. Army engineers in Germany. As a company commander I shared a unit citation with the U.S. partnership unit, Delta Company of the First Infantry Division (Forward), at that time stationed in Neu-Ulm, later in Goeppingen, Germany. The award was presented by CINC USAREUR, General Kroesen. I share many memories with engineer officers and soldiers of the U.S. Army Corps of Engineers who served tours in Germany. Cooperation with U.S. and allied army engineers has always been part of my life in the German military.

During recent discussions, the Commanding General of the Engineer Center, Major General Gill, encouraged me to share some "snapshots" of my tour here with the readers of *Engineer*. Information flow includes both receiving and giving. Having received so much from U.S. Army engineers in the last four years, it is a pleasure to give a little information back. First I will explain the mission and organization of the German Army liaison organization (see chart). In conversations with Americans, I am often asked to describe the German Army liaison officer's job.

German Army Liaison Organization in the U.S.



○ Army Main Liaison Staff	□ Army Liaison Staff
△ Army Liaison Officer	△ Observer/Controller (O/C)
○ USA HHptVStab (USA) Fort Monroe*	U.S. Army Training and Doctrine Cmd (TRADOC)
□ CAC HVStab USA CAC Fort Leavenworth*	U.S. Army Combined Arms Center
□ 1 HVStab USA 1, Fort Lee*	Combined Army Spt Cmd
□ 2 HVStab USA 2, Fort Sill*	Field Artillery Center and School
□ 3 HVStab USA 3, Fort Knox*	Armor School
□ 5 HVStab USA 5, Fort Rucker	Aviation School
□ 9 HVStab USA 9, Fort Benning*	Infantry School
□ 10 HVStab USA 10, Fort Bliss	Air Defense Artillery Center and School/USASMA
△ 4 HVO USA 4, Fort Huachuca	Intelligence Center
△ 6 HVO USA 6, Fort McClellan	Chemical School
△ 7 HVO USA 7, Fort Gordon	Signal School
△ 8 HVO USA 8, Fort Leonard Wood	Engineer Center
△ HVO USMA, West Point	U.S. Military Academy
△ HVO XVIII, Fort Bragg	XVIII (US) Airborne Corps
△ O/C JRTC, Fort Polk	Joint Readiness Training Center

* Installations with a battle lab.

The Commander of the German Armed Forces Command, United States and Canada, is the superior for all German soldiers in the United States, excluding military attaché personnel. He is headquartered in Reston, Virginia. The German Army Liaison Organization, USA, is a subordinate element that is colocated with Headquarters TRADOC, at Fort Monroe, Virginia. It provides a direct means of liaison between the German Ministry of Defense's Army staff with its subordinate elements and selected U.S. Army agencies and facilities. These include TRADOC, the Combined Arms Center (CAC), the National Training Center, the United States Military Academy at West Point, and the service schools and centers with battle laboratories.

In addition to representing the interests of the German Army, the German Army Liaison Organization is tasked to—

- Obtain, evaluate, and assess information on the latest developments regarding U.S. Army command and operational doctrine, organization, training, equipment, and logistics, and to report pertinent recommendations to the German Army Office.
- When invited, inform and brief U.S. agencies and officer and NCO course students on the German armed forces in general or any particular combat engineer subject.
- Attend and report on authorized field exercises and trials.
- Carry out assignments in response to specific requests for information.

While at Fort Leonard Wood I have written more than 100 reports to the German Ministry of Defense. Numerous letters, phone calls in country and to Germany, meetings, and TDY travel activities are also part of the job.

The liaison mission essentially is about communication between our respective armies. At Headquarters TRADOC, CAC, and those U.S. Army centers owning a battle lab, the German

“The mentality and thinking of Americans differ from those of Germans or other Europeans because the United States and its armed forces have never really suffered from a lack of natural resources.”

Army is represented by a main liaison staff or by a liaison staff consisting of at least a senior lieutenant colonel and a sergeant major. Since TRADOC is scheduled to stand up the “Maneuver Support Battle Lab” at Fort Leonard Wood in October 1996, the German Army will keep the sergeant major's position here.

To many, the difference between a liaison officer and an exchange officer seems unclear. However it is very simple: The liaison officer works for the organization that sent him, and the exchange officer works for the organization he is attached to. For example, the German Army liaison officer works for the German Army, while the British exchange officer in the Directorate of Training at the U.S. Army Engineer Center works for the Engineer School's Director of Training.

Let me now provide some impressions. I have enjoyed my appointment at the U.S. Army Engineer Center very much and have seen and learned a lot about the world's only remaining military superpower, the U.S. Army, and the Army Corps of Engineers. Since 1967, the German Army liaison staff at Fort Leonard Wood has always enjoyed working with open-minded people who are aware of the importance of sound allied relations. I have met very few people who were not interested in NATO, allied, and U.S.-German interoperability issues. I have always enjoyed open discussions where I could pass on information about the German Army that is relevant to U.S.-German Army engineer interoperability.

I have a lot of admiration for the U.S. Army. But I would not be frank if I did not admit to some concerns acquired during my dealings with U.S. Army personnel over the last few years.

Doctrine

Military doctrine is subject to many influences and parameters. Today's high technology obviously has a major influence on it. However, it was most interesting for me to learn and understand to what extent resources influence military thinking and doctrine. In this assignment it was important for me not only to get acquainted with the U.S. armed forces but also to learn about American culture by traveling around the country and learning some of your history. I am deeply impressed to what extent the availability or lack of resources influences a nation's mentality and thinking. The mentality and thinking of Americans differ from those of Germans or other Europeans because the United States and its armed forces have never really suffered from a lack of natural resources. Think about that.

Training

The U.S. and German Armies are starting a cross-training program for engineer officers. This program will be relevant for career development and assignments such as liaison officers. The program's payoff will be a broader and better understanding of the capabilities and limitations of both our armies. As a result of this program, the effectiveness of bi- and multinational operations will increase.

Germany sent the first students to the Engineer Precommand Course and the Engineer Officer Advanced Course (EOAC) at Fort Leonard Wood in 1996 to gain a better understanding of U.S. Army engineer operations. On a reciprocal basis, the first U.S. Army engineer officers recently attended the German EOAC at Munich. I do not believe an inability to speak German is



The mine-clearing vehicle Keiler (or "Wild Boar") in action. The Keiler successfully clears both buried and surface-laid land mines. It is employed with the German Army engineer contingent in Bosnia.

an obstacle for this program. Many U.S. Army engineer officers are fluent enough in German and would have no difficulty attending courses at the German Army Engineer School.

Training is a main key to success. Learning about training in the U.S. Army and on Fort Leonard Wood makes me think about the influence of a nation's educational system in general, and vocational training in particular, in providing relevant and useful trade skills. Most of the recruits joining the German armed forces (both regular soldiers and conscripts) are well trained in trade skills. So a plumber, mason, electrician, or carpenter has three or more years of vocational training when he joins the German Army Corps of Engineers. Because the German Army takes advantage of the soldier's civilian trade skills, it must provide training only for his military skills.

I was frankly impressed by the efforts U.S. armed forces must take to provide well-trained soldiers with appropriate trade skills to complete their missions. The engineer Interservice Training Review Organization, recently established on Fort Leonard

Wood and various Air Force and Navy bases, is the evidence. By realizing your training efforts, I have gained appreciation for the benefits that conscription provides in resourcing Germany's armed forces with well-skilled tradesmen.

Army engineers cooperate with coalition forces sometimes down to the company level. This creates a demand for engineer officers and NCOs to have some knowledge of the capabilities and limitations of attached foreign formations. The Euro-NATO Engineer Training Center, hosted by the German Army Engineer School in Munich, has the mission to train military leaders from squad level up to battalion commander in engineer interoperability and standard NATO procedures. Many allied engineer NCOs and officers have attended these courses and should continue to do so.

Sending students to allied nations for training is not just a question of diplomatic relations. Today, joint, combined, and multinational military operations are common. The success of these operations is closely related to the quality of cooperation within the

multinational forces. At least the two binational US/GE-GE/US Army Corps require appropriately trained officers and NCOs. Under such circumstances, it is essential that the participating military forces understand the capabilities and limitations of the national military forces being committed to these special task forces.

Leadership

What is *leadership* all about? Millions of words have been written about leadership, motivation, and counseling. For years scientists have tried to penetrate the human psyche to find more ways of getting the job done.

A leader needs—

- Realism and imagination.
- Receptiveness and strength of character.
- Self-assurance and adaptability.
- Modesty and moral firmness.
- Patience and a sense of justice.
- Inward composure and excellent professional skills.

- Stamina and outstanding physical fitness.

Leaders must decide quickly, courageously, and prudently; promote comradeship; strengthen the sense of responsibility in their soldiers; take resolute action; and set an example.

All of these pearls of wisdom are from just two pages of the German Army Field Manual 100/100, which is equivalent to the U.S. Army's FM 100-5. Had I continued to turn pages, I would have found much more. Do you fulfill all those requirements? I don't! Nor did Frederick the Great, Blucher, Clausewitz, or Rommel. Did George Washington, Patton or MacArthur fulfill them all?

Leadership means the ability to get other people to do what you want them to do. But there are two sides of that coin: First you must know what is to be done; then you must make your soldiers do the job. That involves more than simply issuing orders according to NATO and STANAG regulations. It is more, also, than the ability to inspire or force your will upon others. Hitler, Stalin, Saddam Hussein, and other scoundrels of world history had those qualities. We lead free men and women who think and know their rights. They will fight for a just cause, but we must prove it is a just cause. They will not fight for justice if we treat them unfairly or fight for freedom if we put them down. They will follow us if we prove our honesty and integrity, and if they experience our compassion and morality.

How do we prove that? One simple four-letter word clearly describes what real leaders must do: *care*. We must care about our soldiers and care for them, because anyone who wants to lead people must like people.

If you care, you listen to your soldiers. I don't mean the stilted baloney that some superiors ask: "How old are you, son? Where are you from? Thank you, next man." I'm talking about real listening—because a soldier probably will not tell you when everything is all

wrong. He'll be a little hesitant. If you ask a soldier how he's doing and he just nods or shrugs, you know he's doing poorly and you need to dig a little deeper.

You care if you really wonder what your soldiers do both on and off duty. If PFC Miller does not go to the movies with the rest of the squad, you care if you wonder why. You care if you wonder why PFC Jones has flunked weapons inspection for the third time in a row. And you care if you stand up and tell the commander that your men were not slow but your plan was faulty.

You care if you share their problems, their hardships, and their jokes. Your soldiers are as lousy as you let them be, and they are as good as you make them be.

You care if you make them proud and don't humiliate them. Your soldiers won't be brave if you abuse and cower them—and they won't be strong if you break them. You know they won't be respectful and obedient if you haven't treated them with the respect and dignity that fosters personal pride.

There is a very fine line between firmness and harshness, between strong leadership and bullying, between discipline and "chicken". We must find that line and we will—if we care!

I'm not sure that the following observation is correct, but I've noticed over the past few years that some military leaders act more "boss-oriented" than "mission-oriented." If we get the mission done properly, our boss will be happy. But keeping the boss happy does not always mean getting the job done. Think about that. In my estimation, good leaders focus first on the mission.

Organization

The U.S. Army is focused on Force XXI. In this scenario, we digitize the battlefield using high-tech, state-of-the-art electronic equipment to improve the combat power of the force. Force XXI will consume a lot of energy and resources.

But we Army engineers should not forget that most of the physical and mechanical missions will not be done by computers.

For the foreseeable future, we will still need an adequate number of well-trained "damned engineers" to deal with mud, snow, land mines, river-crossing sites, etc. Planners sometimes forget that future wars, just like those in the past, will be determined by the adequately equipped combat engineer working side-by-side with his fellow soldiers of the combat arms. Reducing the number of combat engineers may lead to a loss in combat power.

Materiel

Today, the U.S. Army's credo is to fight and win the war by first fighting and winning the information war. This vision of "Army XXI" is focused on digitizing the battlefield. In this arena the U.S. Army is second to none. A huge research and development (R&D) world is pushing this issue forward. While visiting U.S. Army, Air Force, Navy, and Marine Corps R&D installations, I noticed some duplication and redundancy of efforts, which is nothing new for a super-sized organization. On the other hand, it may be prudent to focus R&D efforts more on users' needs. Let me explain.

While visiting U.S. Army combat engineer units, I saw aging and worn-out engineer equipment that needs to be replaced. The U.S. Army Corps of Engineers has struggled with this problem during all the years of my assignment at the Engineer Center. I sincerely hope that urgently needed new equipment will be fielded within the next few years. If you need help in the interim, ask your fellow German Army engineers for support. We have engineer equipment, such as the new mine-clearing vehicle Keiler, that may meet your requirements (see photo, page 29).

Soldiers

A resource all armies must handle very carefully is the soldiers. Belonging to an army that recruits female soldiers only to a limited extent, it was a new experience for me to learn about gender-integrated training and equal promotion opportunities for female officers and NCOs. I have followed with interest the ongoing discussions about which positions should be opened to females or kept closed.

I admire the willingness and good morale of young American soldiers—they show pride in what they do. Recently I had an opportunity to visit U.S. engineer units in Bosnia. Even though I spent only a few hours with the Task Force Eagle engineers, I was deeply impressed by their discipline, confidence, and commitment.

I am very grateful to the fine soldiers and officers I served with in the United States. I would go to war with American soldiers any time because I know that I can trust them. They are committed to readiness and dedicated to victory. Many things are done differently over here, but I got reaffirmance again and again that we can rely on our U.S. allies. It has been a privilege to serve a four-year tour with the U.S. Army Corps of Engineers. I thank all of you who I had the chance to meet for your support and friendship. Auf Wiedersehen and Essayons!



Lieutenant Colonel Hocke served as German liaison officer to the U.S. Army Engineer School and Center, Fort Leonard Wood, from August 1992 to September 1996. He previously served as commander of the German 61st Engineer Battalion, 6th Armored Infantry Division; and staff officer engineer and senior combat engineer officer, Headquarters Allied Forces Central Europe. LTC Hocke is a graduate of the German General Staff Officers Course at the Federal Armed Forces Command and General Staff College in Hamburg.

Book Review



Breaching Fortress Europe: The Story of U.S. Engineers in Normandy on D-Day, by Sid Berger. Kendall/Hunt Publishing Co., Dubuque, Iowa, 1994, 272 pages.

By Lieutenant General Daniel W. Christman, Superintendent, United States Military Academy.

Assault landing on a fortified coastline, arguably an army's greatest challenge and an engineer's greatest nightmare, has been masterfully captured by Sid Berger with insight, detail, and thoroughness honed through firsthand experience and in-depth research. A veteran of amphibious operations in Sicily, Italy, and Normandy, the author has written one of the most compelling and comprehensive accounts of Operation Overlord. His focus on engineer units and their tactics and techniques, so crucial to the success of this complex operation, is unique and long overdue.

Breaching Fortress Europe is a definitive and accurate account of the planning and execution of the D-Day assault on Omaha and Utah beaches. Sid Berger has produced a readable story that strikes an excellent balance between a narrative that is easily understood by nonengineers and one that is technically useful to combat engineers and military historians. The significance of the book has been recognized in several independent reviews, one of which was highlighted in the March/April 1995 issue of *Military Review*. One quote from that review captures the essence: "Berger's book should be combined with S.L.A. Marshall's *Night Drop* and Cornelius Ryan's *The Longest Day* for the background and framework upon which these build."

Although other works have portrayed in detail the activities of 6 June 1944, the author's focus on engineer cross-channel planning and engineer support to landing-force preparation and invasion-force marshaling and embarkation is unique and refreshing. His description of the enemy's prepared positions, stretching 2,400 miles with more than 15,000 fortified positions laced with extensive mines and wire obstacles, provides a rich picture of unique engineer factors affecting the operation. By highlighting the engineer units' participation, he leaves no doubt as to the importance of their effort and sacrifice to the successful outcome of the entire operation.

The inclusion of four 18" x 22" full-color, top-secret Bigot maps of Omaha and Utah beaches, one of which the author personally used during his landing on Utah beach, is especially noteworthy. Also of interest are the many original drawings, illustrations, maps, and photographs that depict the varied and complex nature of the operations. A "must read" for the serious student of military history; pure intellectual enjoyment for the rest of us. And for combat engineers, it is a particularly moving, emotional account of heroism that has rarely been equaled in the annals of warfare.

Proceeds from the sale of this book, which was produced by the Society of Military Engineers, will be used to repair and maintain five engineer battle monuments on Omaha and Utah beaches. These monuments are fully described in an appendix to the book.

Note: Engineer is seeking insightful reviews of books of special interest to military engineers. Contributions are welcome.

BCTP: Warfighter Exercises Strengthen Battlefield Performance

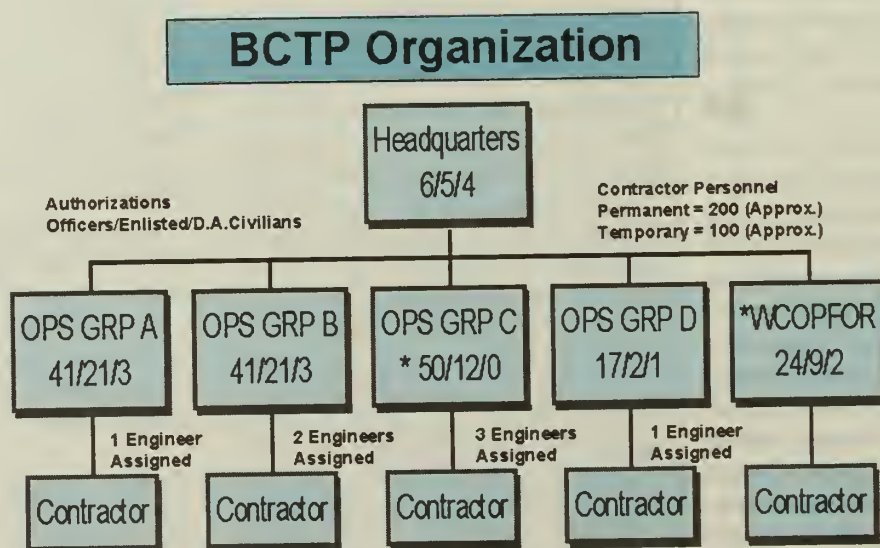
By Lieutenant Colonel Gregory Stanley and Lieutenant Colonel David Snodgrass

The Battle Command Training Program (BCTP) is the Army's capstone combat training center. Initially formed to conduct realistic, stressful exercises for division- and corps-level commanders and staffs, it has expanded over the last three years to include exercises for National Guard brigades and the Army component of joint exercises. The following information describes recent changes in the BCTP and some perceptions (current trends) of the senior observers and observer/controllers based on recent corps and division exercises.

BCTP Missions

The BCTP consists of four lettered operations groups (teams). Operations groups A and B are responsible for the traditional division and corps BCTP rotations. These groups conduct a seminar for the commander, primary

staff, major subordinate commanders, and associated battle staff, ideally within the first 3 to 6 months of a new command. The seminar is normally held at Fort Leavenworth. It offers a unique opportunity for a new commander to divorce himself from the daily peacetime activities of command and to focus specifically on warfighting, team building, and relating his warfighting philosophies to those of his staff and subordinate leaders. Using an order similar to one to be issued during a subsequent warfighter exercise (WFX), the staff conducts portions of a deliberate tactical decision-making exercise. This exercise is a vehicle for initiating professional discussions and information exchanges between unit personnel, observer/controllers, and senior observers. The senior observers are retired three- and four-star general officers who contribute their experience by mentoring the process. (Currently they are GEN(R) Cavazos, GEN(R) Lindsay, GEN(R) Burba, GEN(R) Franks and LTG (R)



Grange.) The actual WFX is conducted at the unit's home station 3 to 6 months after the seminar and pits the unit against a world-class opposing force that fights from the National Simulation Center at Fort Leavenworth. A corps battle simulation (CBS) drives the WFX. (See box for recent improvements to CBS.)

Another operations group, Team C, was added in the summer of 1993. It conducts two phases of realistic and challenging training for Army National Guard brigade and battalion commanders and their battle staffs. In the first phase, the brigade commander, his subordinate commanders, and the brigade staff attend a five-day decision-making seminar at Fort Leavenworth. Observer-trainers lead the staff through the deliberate decision-making process and conduct workshops, a JANUS exercise with the battalions, and an after-action review (AAR). Approximately 3 months later the rest of the brigade command and control cells participate in a 30-hour brigade battle exercise using a brigade/battle simulation that is based on the plan developed during the seminar. Two AARs are conducted during this phase. The same group of senior observers mentor the brigade commander and staff during both the seminar and the brigade/battle simulation.

The fourth operations group, Team D, was formed in 1994. It participates in joint exercises and provides assistance during real-world contingencies. While the other operations groups set up and control exercises, this team focuses on exercises developed and organized by major Army commands and joint commands. Recent examples include Ulchi Focus Lens, in Korea; Frontera Libre, in Panama; and Unified Endeavor, with the Atlantic Command. Team D has also provided assistance with real-world contingency operations in Bosnia, Somalia, and Haiti and for the Southern European Task Force in Italy and the Allied Command Europe's Rapid Reaction Corps. In existence for less than two years, Team D has provided assistance for 22 exercises and contingency operations. No other service has an equivalent organization, making this operations group highly sought after for its expertise in joint operations.

1996 Perceptions

Each year BCTP publishes perceptions of observations from WFXs. These generally are common trends collected from recent rotations that identify areas in which the Army should collectively improve. The following engineer-related observations are from 1995-96 division and corps operations.

Integrate engineer effort into the entire battlefield framework.

Perception: Develop situational obstacles for the deep fight.

Discussion: Scatterable minefields emplaced to support the deep fight often lack a detailed plan for execution and synchronization with other operating systems to achieve a specific effect. As a result, helicopters and Air Force aircraft

CBS Improvements

CBS is constantly changing, and the Engineer School recently made several enhancements to improve the fidelity of engineer play. For those who have not participated in a WFX recently, a summary of those improvements follows:

- Engineers now show up as separate icons and can be task organized. They used to be invisible and conducted work as engineer task teams (ETTs). Because engineer units and equipment now can be seen by opposing forces, intelligence simulation with engineers is greatly improved. This change also allows engineers to continue functions such as breaching while in contact. Formerly, the ETTs would abort work upon any contact with the enemy.
- The number of engineer tasks that can be performed is expanded. Previous versions allowed only one type of minefield. Now the simulation discriminates between surface-laid, buried, antitank, antipersonnel, and scatterable mines. Breaching can be done by various means, such as MICLICs or tanks with rollers and plows, which the operator selects. The time required to complete tasks is based on the resources on hand; the more forces available, the less time required. Multiple breach lanes can be established through all minefields.
- Operations previously done by "work around" now are performed as integral parts of the simulation. (A "work around" is an action taken outside of the simulation through a specific set of rules.) For example, tactical bridges now can be constructed, removed, or destroyed. Fixed bridges can be destroyed or repaired, and runways can be cut and repaired. Point obstacles can be detonated on command.
- Survivability improvements allow specific units to be dug in, according to the survivability levels described in FM 5-103. In previous versions, engineers fortified a piece of terrain, and all units received additional protection by occupying terrain close to the dug-in unit. The simulation now calculates how much earth must be moved to dig in a piece of equipment and applies earth-moving rates to the pieces of engineer equipment allocated to the task. The time required depends on the assets available and what is dug in. The protection is directional and applies only to the equipment, personnel or unit supported.
- Work-arounds have been added to allow for future engineer equipment tested during EXFOR warfighter rotations and Prairie Warrior. These include wide-area munitions, intelligent minefields, the Grizzly, and stand-off-minefield detection systems.
- Efforts are ongoing to drastically improve the corps battle simulation of terrain. Conceptually, rates of movement will vary depending on the slope, condition of the route, and vegetation. The flat terrain board of the current system will be replaced with a three-dimensional model that will affect both aviation and artillery.

"The planning requirement for situational obstacles is the same as that for all obstacles; scatterable minefield delivery systems are just a faster method for emplacement."

are placed at risk emplacing obstacles that have little impact on the enemy, and direct and indirect fires are not planned to take advantage of obstacle effects. Division and corps staffs should identify the named areas of interest (NAI), decision points (DP), and targeted areas of interest (TAI) to support scatterable minefields in the deep fight. The planning requirement for situational obstacles is the same as that for all obstacles; scatterable minefield delivery systems are just a faster method for emplacement.

Perception: Anticipate the transition to the defense.

Discussion: Division and corps staffs seldom plan for battle culmination. Additionally, they do not use the reverse planning sequence, starting with actions on the objective and working back toward actions in the assembly area. As a result, engineers have a difficult time successfully planning and conducting the transition to the defense. Changes to task organizations often are made without considering their potential impacts on current activities or the status of engineer units. During the planning process, units should identify the best terrain to defend throughout the offensive zone and the Class IV and Class V requirements for each potential line of defense. Engineers need that information to determine the task organization changes needed to support the transition.

Perception: Allocate resources to conduct general engineering tasks.

Discussion: Many units sacrifice general engineering requirements in order to support close operations. This may not cause problems during a relatively short WFX conducted in a computer-simulated environment, but it does not replicate the engineer support that maneuver units will expect over a long duration in a deployment. To train as we will fight, units must balance the requirements of the close fight with the general engineering tasks required to sustain units over an extended time period.

Exploit engineer expertise in the intelligence preparation of the battlefield process.

Perception: Engineers seldom "think red."

Discussion: Friendly engineers must be "experts" on enemy engineers. We must know the enemy engineer structure, how they are organized, their equipment, and how enemy engineers are employed in various situations. Engineer planners and S2s use that knowledge to predict enemy engineer actions and the effort required for each identified course of action. We provide that information to commanders, intelligence staff officers, and subordinate engineers. To provide useful tips on probable enemy actions, we must evaluate how, when, and where the enemy uses engineer recon-

naissance teams, mobile obstacle detachments, movement support detachments, and bridge units. Ultimately we want to predict the enemy's main effort and deception efforts. Prediction is the bottom line, not regurgitation of information.

Perception: Continuously estimate enemy engineer capabilities based on the battle damage assessment.

Discussion: Engineer planners should allocate resources based on actual and anticipated requirements derived from enemy capabilities. Many units initially assess enemy capabilities based on known strengths and time available. They often fail to track enemy losses or update their probable capabilities based on the passage of time and changes in strength. As a result, friendly units often find themselves facing more (or occasionally less) engineer effort than anticipated and templated. Many units allow the enemy to construct or improve his defense. They tend to ignore enemy engineer targets in favor of enemy air defense, artillery, and command and control targets. Enemy engineers should be considered in the division and corps high-payoff target lists.

Perception: Template and disseminate enemy engineer effort based on their known capabilities.

Discussion: Engineers should apply their knowledge of terrain and enemy engineers to template enemy engineer efforts. This template, derived from known enemy engineer capabilities, should be revised and updated frequently to reflect new data gathered in a focused and integrated information-collection effort. Units should devise a system to disseminate the template when it is revised. The All Source Analysis System (ASAS) is a great option for disseminating information. The engineer S2 can also use ASAS to search for reports of enemy engineer activities the G2 might not otherwise disseminate. Unfortunately, not all divisions resource their engineers with ASAS.

Perception: Coordinate efforts of the engineer S2 and the G2 to take advantage of their individual strengths.

Discussion: Units must delineate intelligence responsibilities for products based on the skills each intelligence officer brings to the collective table. Many units duplicate efforts on enemy obstacle tracking, with both the G2 and the engineer S2 following reports and tracking obstacles. Often, neither of them uses confirmed obstacle reports or their knowledge of terrain, enemy capabilities, and enemy doctrine to template additional obstacles. Coordinating their efforts will focus data-collection activities and enhance the picture of the enemy defense. The engineer S2 offers the unit a tremendous capability when he maintains and updates the obstacle database for the entire unit because he can ensure that all subordinates have

access to a common picture of the battlefield. With that database and his unique knowledge of terrain, defense construction techniques, and enemy engineer capabilities, the engineer S2 is the ideal person to assign obstacle templating responsibilities. Updated obstacle status and templates based on dynamic enemy engineer capabilities give commanders (including subordinate unit commanders) and their staffs valuable clues to identify the enemy defensive array. Division engineers should get an ASAS terminal for their S2 and exploit ASAS to assist in this function.

Integrate obstacles to enhance other battlefield operating systems.

Perception: Develop an obstacle plan that supports the scheme of maneuver.

Discussion: Divisions often decentralize obstacle plans down to the brigade level but fail to synchronize brigade efforts to ensure a coherent division defense. As a result, one brigade may plan and construct a belt that turns the enemy into the flank of another brigade. Some plans lack a concept for obstacles. Units should ensure that obstacle intents match the maneuver intent and concept of operation. One option to ensure compatibility is to use intent graphics at the division level. Another option is to review the obstacle plan and intents during each division backbrief and rehearsal.

Perception: Refine obstacle-control measures to focus engineer effort and materials.

Discussion: Divisions often do not want to restrict maneuver brigade commanders, so they design zones that cover entire brigade sectors. As a result, each brigade fights a separate fight not a division fight. Failing to focus obstacle-control measures to specific enemy avenues makes it difficult to determine obstacle resource requirements.

Perception: Provide meaningful information on friendly and enemy obstacles.

Discussion: Dissemination of obstacle information is extremely weak. Units lacking a staff engineer (field artillery, air defense artillery, signal, and corps units) either do not get obstacle information or fail to use it. Units, especially those with several types of communications systems, must develop a method that is easy to use and facilitates dissemination. Generally, the DIVEN S2 cell is the ideal group to develop a single, common database and disseminate it over a tactical local area network or via TACFAX. The cell also must maintain an overlay that identifies cleared lanes and obstacle-control measures. Engineers must be involved with movement control, and maneuver units must enforce procedures to ensure that all movement within their sector is coordinated with their engineer representatives.

Perception: Address obstacles during rehearsals.

Discussion: Discuss the intent for obstacles during rehearsals. This practice will reduce the chance of diverting

engineers for lower priority missions and ensure that obstacle plans support the commander's intent and the unit scheme of maneuver.

Perception: Plan obstacles that support offensive operations.

Discussion: Obstacle-control measures are rarely discussed in plans for offensive operations. FM 90-7 describes techniques for obstacle planning in the offense. Obstacles are an engineer weapons system that, when properly employed and integrated with other operating systems, can wrest the initiative from the enemy. Many commanders hesitate to delegate emplacement authority for FASCAM during offensive operations but rarely restrict the use of other obstacles. As a result, a unit is guaranteed not to face a "temporary" obstacle that will self-destruct in another hour or two but potentially runs the risk of dealing with such "semipermanent" obstacles as road craters or conventional minefields. When defining delegation authority, commanders must consider differences in sighting accuracy and marking methods between aerial- and ground-delivered FASCAM as well as potential areas of employment.

Perception: Synchronize FASCAM to maximize effects.

Discussion: FASCAM capabilities are not understood by all, so they are rarely exploited during combat operations. Many commanders tend to consider field artillery (FA) delivered ADAM and RAAM only. When FA-delivered FASCAM is used, it tends to be a "Call 911" approach. In that situation, nobody can maintain a clear picture of all of the FASCAM self-destruct times or safety zones. Once again, the planning requirement for FASCAM obstacles is the same as that for all obstacles; scatterable minefield delivery systems are just a more rapid method for emplacement. The bottom line is that obstacles must be emplaced for a specific effect and be targeted with direct and indirect weapons systems to take advantage of enemy delays at the obstacles. If the timing of an obstacle is critical to mission success, units must identify the NAIs, DPs, TAIs, and observation required to support the scatterable minefields.



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Lieutenant Colonel David Snodgrass is the BCTP engineer observer/controller. Previous assignments include commander, Bravo Company, 17th Engineer Battalion; assistant division engineer in 2d Armored Division, Fort Hood, Texas; and light and armor team engineer observer/controller at the National Training Center, Fort Irwin, California.



CTC Notes



National Training Center (NTC)

Engineer Platoon Critical in Defense Planning and Execution

By Major Tom Buning

Engineer battalions and staffs are not using the time and resources available to them to sufficiently prepare detailed plans for countermobility and survivability efforts for their subordinate commanders. Poor adherence to the principle of parallel planning between the engineer battalion staff and the brigade staff results in the issuance of incomplete and poorly staffed orders to engineer company commanders. This problem often increases in magnitude as similarly incomplete orders are issued to platoon leaders. As a result, platoons are left with an overwhelming responsibility to complete obstacle plans, coordinate for and haul Class IV and Class V barrier material, and execute the plans. Since platoon leaders are trained and manned only to *execute* obstacle plans, platoon productivity takes a drastic nosedive.

Philosophically, the engineer battalion and company headquarters staffs must realize that there are only six line platoons capable of emplacing barrier obstacle plans in the battalion. Commanders, staff officers, and noncommissioned officers must work together to maximize the platoons' outputs and to ensure the outputs are properly synchronized. All

planning functions must be accomplished by the higher headquarters in direct proportion to the size of the staff available. The only acceptable end results are the issuance of an execution order to a platoon leader that requires obstacle siting as part of engagement area development (as outlined in FM 90-7) and disciplined compliance with executing squad and platoon obstacle-emplacement drills.

Standard planning factors for platoon efforts, in terms of minefield frontage emplaced over time, are based on the understanding that an engineer platoon is responsible only for emplacing obstacles. It is no wonder that battalion staffs, as they trace the execution glide paths for the brigade and engineer battalion commanders, often see the platoons' performance fall behind more than 50 percent. Units must take several steps to fix this situation. They include but are not limited to the following:

- Brigade operation orders (OPORDs) must include directed obstacle and survivability efforts to be executed before the battalion task force orders are issued. To start smart, task organize engineers and issue detailed warning orders early. The brigade obstacle plan must include all directed obstacles (with sufficient details to execute) and brigade obstacle belts, including intent graphics, priorities, and resources to be provided. The assistant brigade engineer must use these resource planning factors to determine the Class IV and Class V requirements to support the belt intents.
- Brigade orders must direct Class IV/V point locations and amounts to be delivered from Corps. Details on Class IV/V point management responsibilities and augmentee manual labor must be directed in the main body of the brigade OPORD. Class IV/V point locations must have the following essentials: someone in charge with engineer expertise, copies of the obstacle plan and orders, communications requirements, materiel handling equipment, and labor.
- The brigade OPORD must direct the earliest possible time and place for maneuver commanders and supporting engineer leaders to link up and site battle and fighting positions, site-engagement areas, and target reference points.
- Units must consider a unit basic load of Class IV/V materials to resource early emplacement efforts by engineer platoons as mission loads are brought forward. The engineer company and battalion support platoon's heavy expanded mobility tactical trucks (HEMTTs) must be ready to support the distribution of Class IV/V materials forward to the mine dumps. The key is to reduce the time engineer squads need to travel and load Class IV/V materials into their trailers.
- Staff discipline and practice orders drills, led by the executive officer in his role as the chief of staff, are critical to engineer success in owning the mobility and survivability battlefield operating systems for the brigade combat team. Brigades must take ownership of the fight and

rid themselves of the notion that task forces and engineer companies should have the planning freedom to "fight their own fight."

- Engineer commanders must plan for the use of FASCAM both situationally and conventionally. The best planning considerations for VOLCANO are to complete conventional obstacles that were planned but not executed prior to the defend time or to reinforce the conventional effort, as described in Chapter 7, FM 90-7.

Platoons that do not emplace obstacles because they are coordinating unclear plans, running down materials, responding to faulty intelligence, or "Black" on water are not adequately supported by their higher level commanders and staffs. The platoon "lane" is to site and emplace obstacles. The battalion and company lane is to take care of all else so the platoons can do their work.

The most important qualifier for successful engineer counter-mobility and survivability operations is to properly synchronize obstacle effects where the brigade wants to kill the enemy and from what location. This task is critical! Failure to properly synchronize obstacle effects with maneuver and fire may not only render thousands of engineer counter-mobility man-hours useless but, more importantly, jeopardize the success of the mission.

By addressing the above steps, units can maximize the use of their available time, forces, and materials to produce the most effective obstacles.



Joint Readiness Training Center (JRTC)

Engineer Command and Control at Brigade Level

By Major Jim Brooks

Recent improvements are noted in the integration of brigade engineers into the brigade tactical operations center (TOC) and the brigade decision-making process. The brigade main engineer cell (BMEC) is typically manned by a brigade engineer or assistant brigade engineer (usually a first lieutenant who formerly served as a platoon leader or a

captain just out of the Engineer Officer Advanced Course), a borrowed vehicle with radios and a driver (not authorized on the modified table of organization and equipment [MTOE]), a few noncommissioned officers (operations, communications, or NBC), a digital nonsecure voice telephone (DNVT) for connectivity to the mobile subscriber equipment network, a tactical fax machine, and a notebook computer with a printer. Most brigade TOCs now allocate sufficient space for the brigade engineer to effectively set up appropriate map boards and overlays and to display current engineer battle-tracking charts. This personnel and equipment support is critical to sustained battle tracking, staff integration, and 24-hour operations.

Options. FM 5-7-30, Chapter 2, shows a sample organization for supporting engineer cells. When followed, this organization has proven to be more successful than others observed at the JRTC. Engineer companies on rotation here typically use one of two organizations for engineer command and control. Some units position a brigade engineer in the brigade TOC, while the rest of the company headquarters section operates in a separate company command post (CP) within the brigade support area. Under this organization, the company CP tracks the current engineer situation and the brigade engineer plans future operations. Because challenges exist in communicating current and future operations between the BMEC and the company CP, the brigade engineer is usually unable to keep the brigade commander and staff accurately informed on the current status of engineer operations. Also, task force engineers frequently are over-tasked to report the same mission status to three nodes: the engineer company CP, the brigade engineer cell, and the maneuver commander.

Other, more successful, engineer companies divide the company headquarters to integrate engineers into both the BMEC in the brigade TOC and the brigade rear engineer cell (BREC) in the forward support battalion TOC. The company first sergeant establishes company trains in the brigade support area. The BMEC is manned and equipped with assets from the company CP and can track battles accurately and quickly. As a result, the brigade engineer can keep the brigade commander and his staff informed on the current status of engineer operations, and he is available for better integration into the planning process and sustainment of 24-hour operations. This organization also reduces the reporting requirement nodes for battalion task force engineers.

Bottom Line. Determine the command, control, and staff integration requirements of the brigade task force, then adjust the task organization of the available engineer assets. For long-term solutions, submit MTOE changes for additional equipment and personnel in the brigade engineer cell. For the short term, given the current MTOE of light, airborne, and air assault engineer companies, it is more efficient to take personnel and equipment formerly used to conduct current operations within the company CP and use them to strengthen the BMEC and the BREC in the brigade main and rear CPs.

Shaping the Electronic Battlespace: **The HEXJAM**

By Captain Dale A. Kornuta and First Lieutenant Brian R. Dunmire

Engineers fight obstacles! Webster defines obstacles as something, material or non-material, that stands in the way of literal or figurative progress. For engineers, obstacles are the task force defense—mines and wire. While not very exciting, they are very effective when properly integrated. They were responsible for 20 percent of tank losses in World War II.

Now engineers have discovered a new obstacle: the hand-emplaced expendable jammer (HEXJAM). It can jam the complete spectrum of frequency-modulated (FM) radios, both single-channel and frequency-hopping!

The HEXJAM is known in the military intelligence (MI) community as a barrage jammer. Since the MI branch is no longer the proponent for hand-emplaced jammers, MI battalions may transfer these devices to engineer units.¹

History

FORSCOM fielded the HEXJAM as an electronic warfare communications device to divisional and corps MI units about 10 years ago. As a one-time issue, Class IX expendable item, accountability for the HEXJAM is maintained at the company level. This means that many MI S4s or property book officers may not know they exist.

There are two problems concerning ground-based jammers:

- To overpower enemy radios, friendly jammers must create a huge radio signature that is easily detected by enemy direction-finding equipment. The large signature makes them artillery magnets, since no enemy commander will tolerate disruptions in his communications.
- To jam an enemy's communications, we must know his radio frequency. We must determine when to jam and then reacquire



The hand-emplaced expendable jammer (HEXJAM) is a lunch-box-sized broad-band communications mine.

Photo by Jennifer Morgan

HEXJAM Characteristics

- Can be set up in 3 minutes.
- Jams all former Soviet bloc radio frequencies; severely restricts radios used by U.S. and NATO forces.
- Operates when buried up to, but not over, the top of the system.
- Range (classified information).
- **WARNING:** A nonhazardous, nonreversible, self-disabling capability prevents unauthorized reuse. Use only the training setting; the operational setting activates the self-destruct feature.
- Activated by a timer, with up to 29.9 hours delay.
- Jams continuously for 2 hours with one SINCGARS battery or for 4 hours with an external adapter and two SINCGARS batteries.
- Can be command activated by shunting wires attached to mounting posts (does not require a blasting machine).
- Has a shelf life of more than 10 years without batteries installed.
- Operates in blackout conditions; has no visual or audio signature.
- Smaller and lighter than an M21 mine, it is made by Fairfield Weston/Schlumberger, Model No. 4286-031. It uses a BA-5590 battery.
- No maintenance actions are authorized. A built-in test check, which includes battery installation, may be exercised at any level; however, it is performed primarily by deployment forces (engineers).
- Requires minimal training to operate (instructions are printed on the device).

the target after jamming. This limits the number of nets that a unit can attack.

Because the MI jamming mission is operational and strategic, a vacuum is created at the tactical level. The HEXJAM fills that vacuum, but the MI community does not have—and does not intend to have—personnel operating where tactical operations occur. Engineers do, and can fill that gap.

Future

We must train young engineers to attack the battlefield—not just the ground—by making them aware of new technologies in our arsenal, such as the wide area mine (WAM), the hush flare, and the HEXJAM. The WAM destroys low-flying aircraft and helicopters. The hush flare (a directional ground flare) prevents the enemy from using thermal and passive night sights. The HEXJAM denies the enemy the FM portion of the electromagnetic spectrum.

Obstacles in the electromagnetic spectrum (such as radios; microwaves; global positioning system receivers; and laser, visual, and thermal sights) must be part of the ground that we shape. We engineers must not restrict ourselves to destroying vehicles and personnel but concentrate on achieving the commander's intent. Disrupting the enemy's command and control slows or desynchronizes his maneuver, thereby supporting the killing systems of the task force. Disrupting the enemy's motorized rifle company or battalion while it conducts breaching operations can have a ripple

effect reaching all the way up to regimental headquarters. Such disruptions may force him to commit follow-on forces early to make up for the forces destroyed in the breach.

Jam Field

A jam field is any HEXJAM or group of HEXJAMs that deny the enemy effective communications on a particular piece of terrain. A jam field is difficult to detect. The enemy hears no static while his equipment is being jammed but clearly hears friendly vehicles nearby. Since jamming only affects reception, everyone outside the jam field can hear vehicles within the field. Therefore, enemy units do not realize they are being jammed even though they cannot communicate with elements of their force at the most critical juncture in their operation.

If the enemy's direction-finding systems find the jammers, they can only report that fact, because the standard opposing force (OPFOR) tactic is to use heavy artillery or rocket launchers to destroy jammers. His problem now is that the jammers are "in the wire" with his forces.

The HEXJAM's small size and delayed activation make it a flexible munition. Its disrupting effect is truly nondiscriminatory, affecting engineer, artillery, and maneuver personnel. Engineers in the breach—or one terrain feature short of the obstacle—lose their communications. Forward observers supporting the breach experience disruptions. The assault force awaiting the breach and the support-by-fire team that never gets the call to mass or shift fires are also affected.

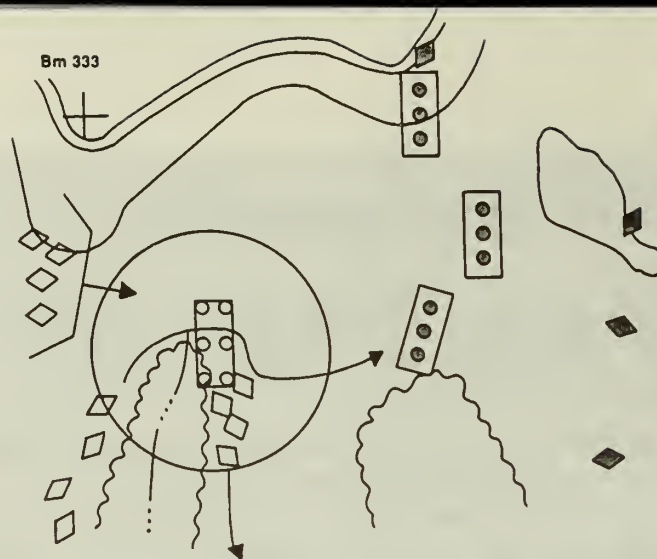


Figure 1. OPFOR Deliberate Breach Deployment

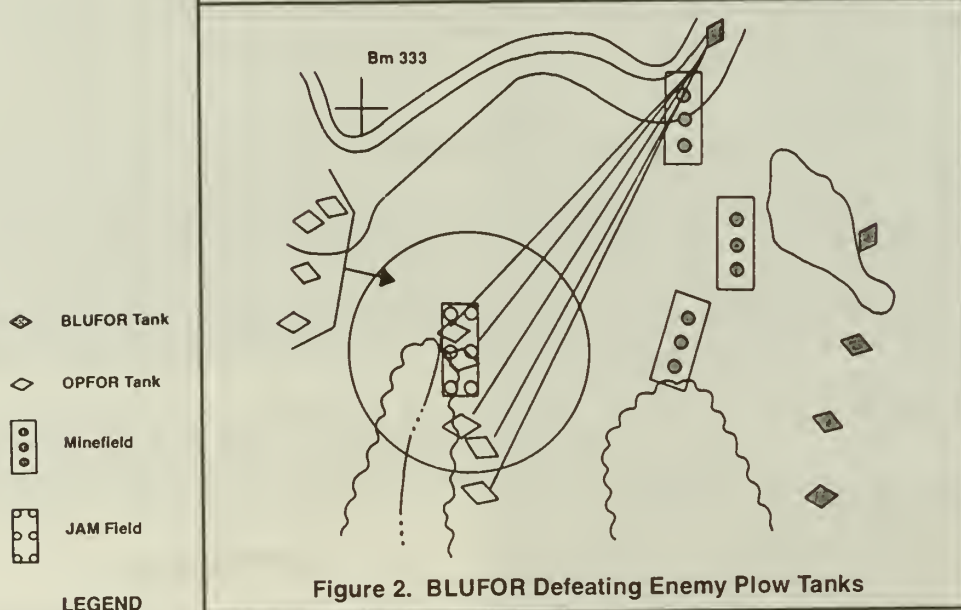


Figure 2. BLUFOR Defeating Enemy Plow Tanks

When the enemy is in the defense, HEXJAMs pushed forward with the scouts isolate security forces, thereby disrupting the entire enemy security zone.

Operations

Alpha Company, 588th Engineer Battalion, Fort Hood, Texas, used the HEXJAM during recent training. The following examples typify the effects the HEXJAM produced on the battlefield.

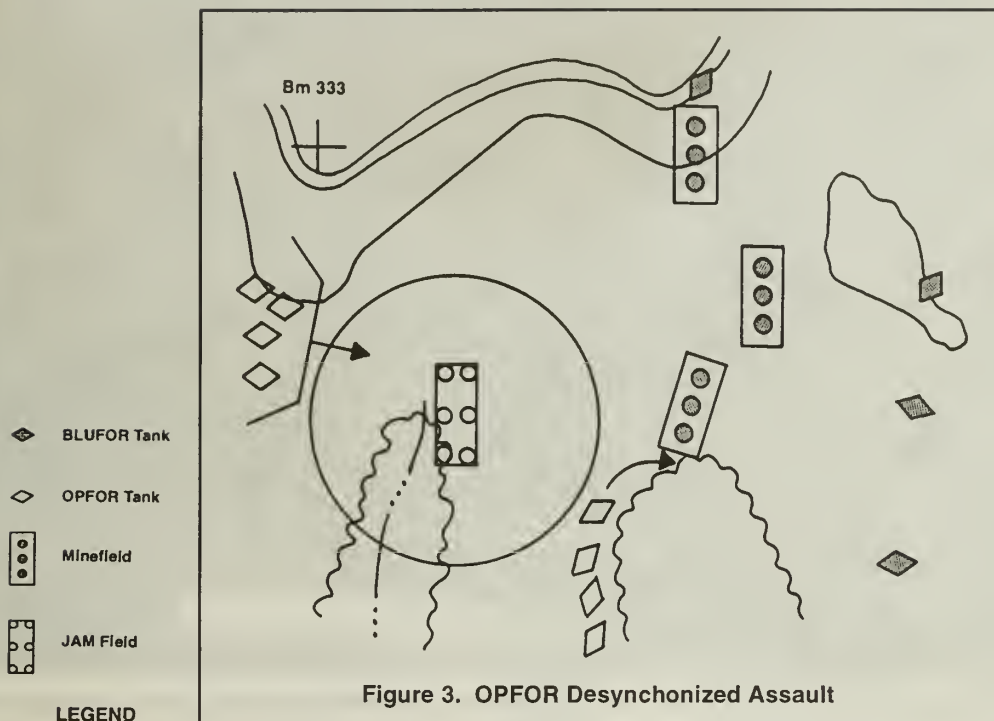
Action. Company/team lanes were conducted in the 1-kilometer-wide avenue of approach south of Bench Mark 333 (Figure 1). The ground the maneuver commander chose for his defense was bound by a steep, wooded mesa on the north and forested, low ground on the south. The jam field was placed forward of the main defensive belt in the low ground and covered by the keyhole tank on the extreme north of the main defensive position.

The OPFOR tank company maneuvered to conduct a deliberate breach. The support force deployed on the

intervisibility line south of Bench Mark 333 and established a support-by-fire position. The jam field was activated using the time-delay function, which allowed the engineers to clear the battlefield before the direct-fire engagement.

The support force skirted the low, vegetated ground in the south and the OPFOR commander moved with his breach force of four plow tanks into an attack position within the jam field. The attack stalled for 10 minutes while the OPFOR commander attempted to regain communication with his platoons. In the absence of orders, the security force worked the low ground to the south, off the map and out of the battle. The blue force (BLUEFOR) keyhole tank then annihilated all the plow tanks in a short, one-sided fire fight (Figure 2). Eventually, based on the platoon leader's understanding of the commander's intent, the security force conducted a desynchronized platoon attack (Figure 3, page 41).

Effects. The OPFOR commander and plow tanks were effectively removed from the fight, desynchronizing the attack. The commander never realized he was being jammed because he maintained constant communication with his wing tank even though he lost communication with all of his



platoons. The security force passed through the jam field with little effect, because it was not assigned a critical mission at the location of the jam field. The jam field was covered with fires, allowing it to produce the maximum effect.

Action. During Task Force Lane's offensive operations, scouts from the 3-67 Armored Battalion, Fort Hood, placed HEXJAMs near vacant enemy fighting positions before the positions were occupied. With less than 10 minutes of instruction, the scouts effectively employed the HEXJAMs. The devices were activated using the time-delay function based on line of departure plus movement time.

Effects. Tank commanders were observed dismounting to develop hasty hand and arm signals, which became their only means of communication during the battle. Lacking radio communications, the tanks could not coordinate direct fires. Their higher headquarters could not effectively control them nor could they carry out the plan for indirect fires, since they could not hear their fire support officer. This led to destruction of the tanks and desynchronization of the OPFOR defensive fight.

Strengths

The HEXJAM is an inexpensive, simple, and effective tool that has a tremendous effect during training exercises. Because there are no open frequencies to jump to, the broad-band jamming makes conventional antijam techniques ineffective. It can be set up in 3 minutes, requires minimal training, and is capable of continuous jamming operations for a period of 2 hours with one single-channel,

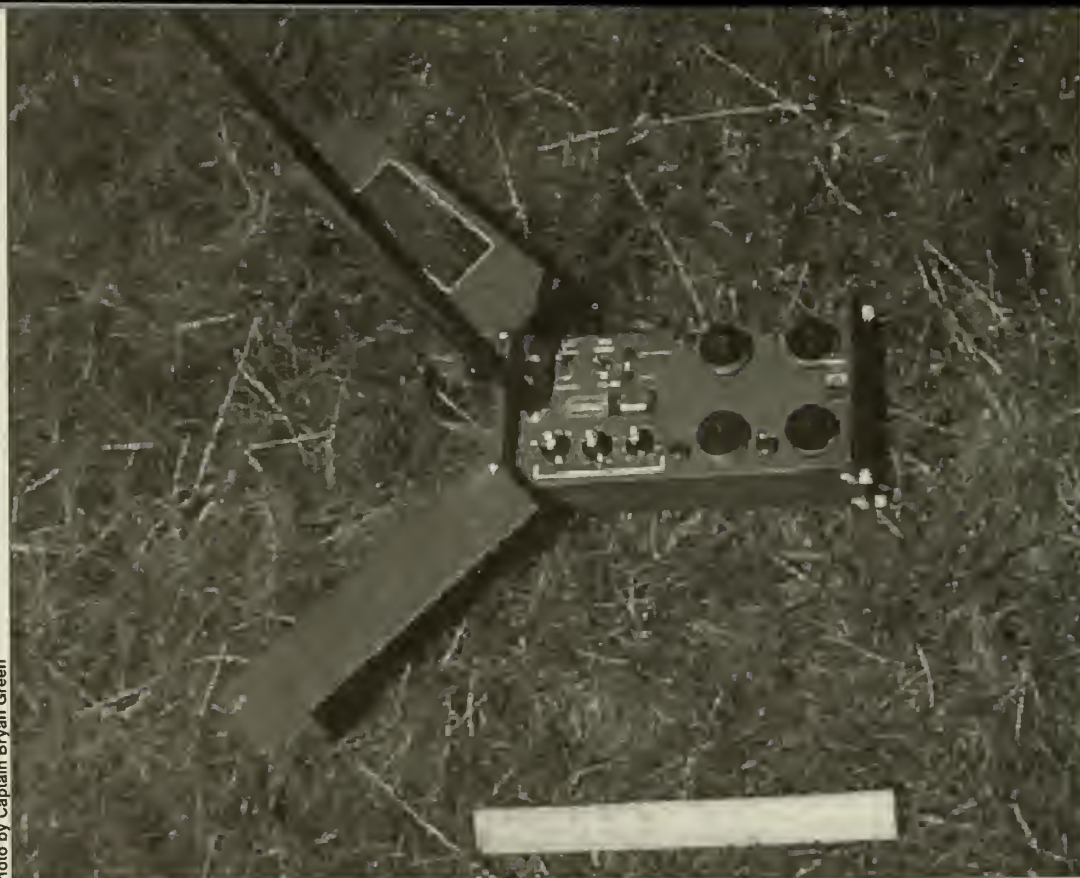
ground-to-air radio system (SINCGARS) battery. The HEXJAM is nonhazardous and nonreversible and has a self-disabling capability which prevents unauthorized reuse by the enemy. It can be activated by a timer with up to 29.9 hours of delay (see chart on page 39). The command activation system is accomplished by shunting ordinary wire. Many HEXJAMs can be "daisy chained" together. The effective area of the HEXJAM indicates the capabilities of the next generation of mines being fielded.

Limitations

Like any minefield, the HEXJAM must be integrated into the scheme of maneuver. Most importantly, the jam field must be placed where the enemy needs to communicate via FM radio. Integrating engineers into the S2's intelligence preparation of the battlefield (showing the enemy's decision points) is critical to the successful emplacement of the HEXJAM.

Communications minefields will require special rules of engagement or obstacle restrictions, such as in observer/controller locations. Its short operational time requires excellent intelligence on the enemy time line or command detonation. The batteries required for the HEXJAM must be requested through the task force several months before a training exercise. The new rechargeable SINCGARS batteries will mitigate this drawback somewhat.

The HEXJAM was designed to target potential enemy radios. As a possible friendly antijam TTP (tactic, technique, and procedure), single-channel antijam frequencies are available at the top of the FM radio spectrum.



The HEXJAM works by denying the enemy the FM portion of the electromagnetic spectrum.

The HEXJAM is no longer in the supply system. It is available from the Delta Company (General Support) or the Long Range Surveillance Company of any military intelligence battalion that has had continuous service since 1985. This device is out of the system but not "out of supply." The 588th Engineer Battalion has obtained 22 HEXJAMs. Now each line company can deny the enemy significant portions of the engagement area.

The hand-emplaced jammer is not a sensitive item or a classified device, but its range and power output are classified "confidential." The exact specifications are published in Training Circular 34-98, *Expendable Jammers* (U), 29 May 1984 (a confidential document). This pamphlet, which offers excellent TTPs for engineers, is available at the same units where the HEXJAMs are obtained.

Conclusion

The effect of denying the enemy communications on a particular piece of ground is similar to blowing a track to disrupt his formation. The usefulness of this weapon is limited only by the imagination of the commander, the S2 who knows the location of the enemy's decision points, and the engineer or scout who emplaces the device.

The HEXJAM must be added to the task force engineer's equipment. Although current supplies of HEXJAMs are adequate for training units in peacetime, they are not adequate for wartime needs.

The strengths and limitations of the HEXJAM must be developed through the normal training cycle so we can

employ them to better defend ourselves from similar devices fielded by adversaries. In the Force XXI era, this simple, inexpensive combat multiplier will help ensure that the Army achieves success on the modern battlefield.

Endnote:

¹ The memorandum authorizing engineers to obtain HEXJAMs from MI units is on file at the Directorates of Battle Lab Support and Combat Developments, U.S. Army Engineer School, Fort Leonard Wood, Missouri.

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First Lieutenant Brian R. Dunmire is the S2, 1-10 Cavalry Squadron, 4th Infantry Division (M), Fort Hood, Texas. Previous assignments include XO of D/104th Military Intelligence Battalion; collection and jamming platoon leader, D/522d Military Intelligence Battalion; assistant S2, 1st Brigade, 2d Armored Division, all at Fort Hood. He is a graduate of the Military Intelligence Officer Basic Course and the Airborne School and holds a degree from Pennsylvania State University.

Send your ideas about shaping tactics and techniques of future engineers to CPT Bryan Green, the Battle Lab Integration Officer, (573) 563-7355 or DSN 676-7355.

Maintaining the MICLIC

By Captain Joe Birchmeier, Sergeant First Class Terry Purdin,
and Sergeant First Class Ted Roberts

The Mine-Clearing Line Charge (MICLIC) is a critical mobility asset—even with its limitations. Engineers use it to clear a path through obstacles without having to dismount.

The following information will help engineer units reduce or eliminate some common problems associated with the MICLIC. Units should follow these techniques and procedures in conjunction with those in Technical Manual (TM) 9-1375-215-14&P when performing maintenance or training on the MICLIC system.

Most of the MICLIC problems observed at the National Training Center (NTC) are attributed to—

- Poor unit maintenance.
- A lack of system knowledge at both the soldier and the leader level.

Poor readiness rates occur in units that do not maintain the complete system. Units have arrived at the NTC with launchers or trailers that were "up" to -10 standards; however, the system was "down" due to a faulty firing cable. A weakness of TM 9-1375-215-14&P is that it does not require a check of the complete system during the preventive maintenance checks and services (PMCS).

Deficiencies in leader/soldier knowledge of the system result from insufficient training. Because most units do not fire the line charge often and lack a complete training aid, they arrive at the NTC improperly trained in MICLIC operations. The end result is long MICLIC preparation times and high misfire rates.

PMCS of Launcher

Problem. TM 9-1375-215-14&P does not provide enough detail about the U-bolts that attach the launcher to the trailer or the armored vehicle-launched MICLIC (AVLM) mount. Many units arrive at the NTC to fire live line charges with U-bolts missing from the launcher.

Solution. The launcher must be secured with four U-bolts. If any U-bolts are missing or loose, consider the system nonmission capable.

Problem. Some units conduct a PMCS of the MICLIC system without checking the M34 blasting machine. Some units arrive at the NTC with only one operational M34.

Solution. Two M34 blasting machines should be available when the MICLIC is operated. Check the M34s with a

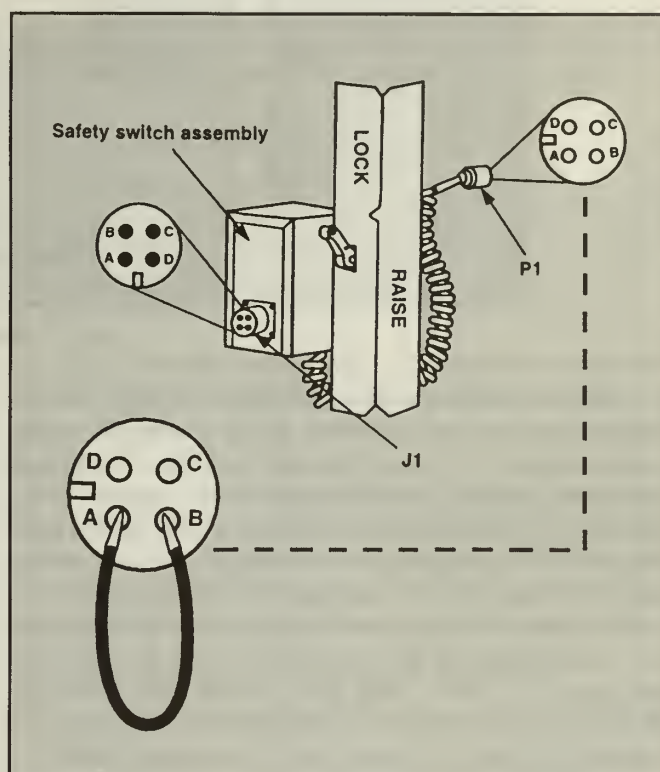


Figure 1

multimeter. To be used with the MICLIC, the M34s must produce at least 222 volts DC.

Problem. Units do not check the firing cable and safety switch for continuity when they conduct a PMCS of the MICLIC without a line charge or rocket.

Solution. Use the M51 test set and a 3-inch piece of communications wire with the ends stripped. Connect the firing cable to the J1 plug (Figure 1) on the safety switch. Attach the selector switch to the other end of the firing cable. Taking the 3-inch piece of communications wire and the P1 cable, jump the pin marked "A" and the pin marked "B" (Figure 1). This check replicates a line charge and will check both the firing cable and the safety switch.

Note: If a light does not come on when the launcher arm is in the raised position, test the safety switch. If the safety switch is operational, the firing cable is defective.

Problem. When checking the firing cable, a light appears when the launcher arm is in the lowered position; or there is no light when the launcher arm is in the raised position.

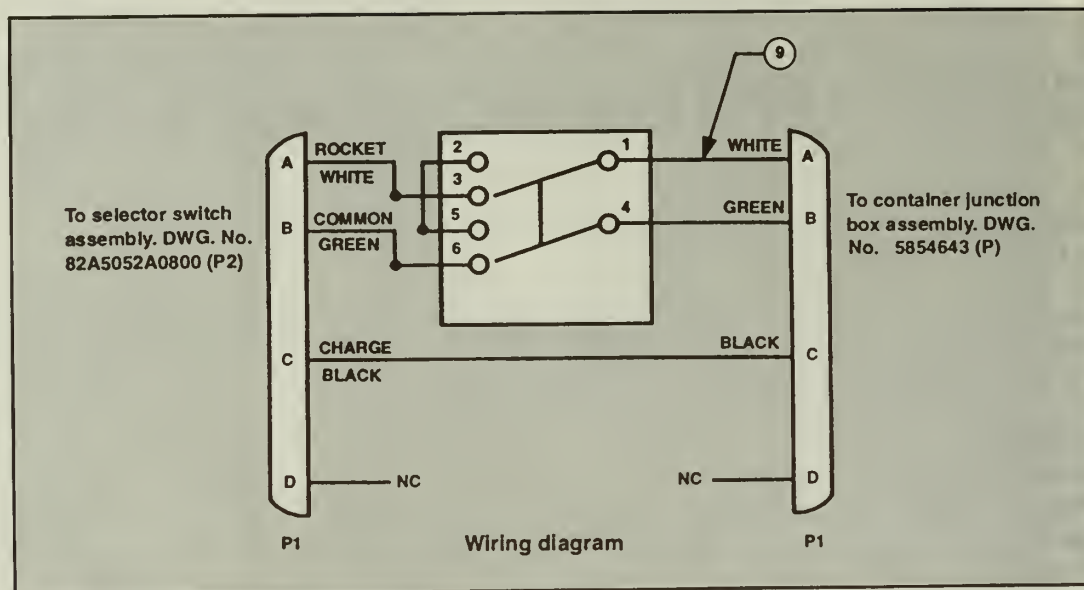


Figure 2

Solution. Using a multimeter, check the safety switch. Disconnect the firing cable from the J1 plug on the safety switch (Figure 1). Look at the pin inside the J1 plug and identify the A, B, C, and D pins. Do the same on the electrical plug (P1) that hangs from the safety switch. Set the multimeter for OHMS to check for continuity or a closed circuit. Insert the leads from the multimeter into the A pins at the J1 and P1 plugs. When the launcher rail is in the lowered position, there should be an open circuit. Repeat the procedure for pins B, C, and D. Only pin C should have continuity. With the launcher arm in the raised position, there should be continuity in pins A, B, and C. Pin D is not used (Figure 2).

Note: If there is continuity in pins A and B in the lowered position, or if there is no continuity in pins A and B in the raised position, refer to TM 9-1375-215-14&P (pages 5-8) and adjust the roller switch lever. If the safety switch checks out after adjustment, recheck the firing cable for continuity.

Problem. The line charge is not properly secured to the trailer or the AVL M.

Solution. For the trailer-mounted MICLIC, the line charge must be connected to the trailer with four turnbuckles and locking nuts. Tighten the turnbuckles, but allow threads to show on the inside of each end. Then tighten the locking nuts to ensure that the turnbuckle will not unthread itself. Use two chains and binders for the AVL M. Pull the hook and chain through the rear line charge tie-down and attach the hook to the chain approximately 6 to 8 inches from the charge tie-down (Figure 3). Route the chain through the rear launcher tie-down to the front launcher tie-down, up through the front line charge tie-down, and attach the hook approximately 6 to 8 inches from the charge tie-down. Install the binder under the center and ensure that the binder handle is facing rearward. After the binder is locked, secure the binder handle with tape. Repeat these steps for the other side of the charge.

Setting Up the Line Charge and Rocket

Problem. The MICLIC line charges sink due to settling, which may cause them to deploy erratically and/or misfire.

Solution. Inspect the line charge as soon as it is opened. The line charge should be flush with the sides of the container. If it sinks more than 1 1/2 inches, do not use it. Return the line charge to the ammunition supply point for inspection.

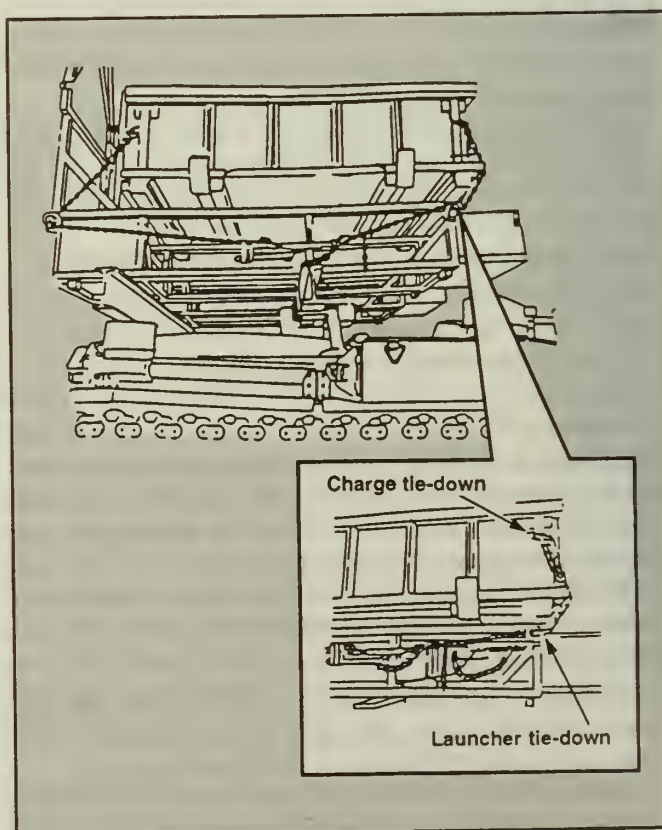


Figure 3

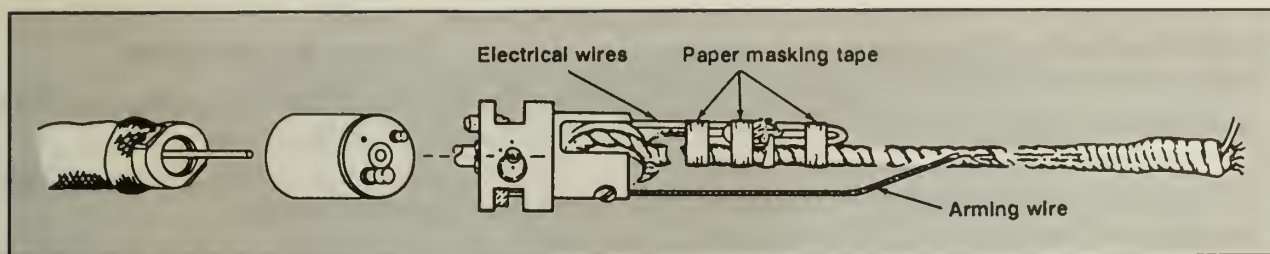


Figure 4

Problem. TM 9-1375-215-14&P does not describe how to ensure that the arming cable will not cut the firing wire at the base of the fuze.

Solution. As part of each MICLIC preparation, pull back the nylon sock from the arming cable side of the fuze connector. Align the electrical wires on the side opposite the arming wire and neatly tape them with paper masking tape (Figure 4). Return the nylon sock to its original position.

Problem. The rocket bridle cable slips out of the cable sheath.

Solution. The improved method of taping the rocket bridle cable to the launcher rail is to tape the bridle in two places—just to the front and just to the rear of the cable sheath. Use electrical tape (Figure 5) to keep the bridle cable from moving back and forth. Ensure that the bridle forms an “S” shape when it is laid on top of the charge and connected.

Problem. Some rockets come unlocked, due to excessive stress on the launcher rail, while traveling across rough terrain with the rocket attached to the MICLIC launcher.

Solution. Ensure that the rocket locking mechanism locks the rocket in place. Always travel with the ball-lock pins in the LOCK position. To keep the rocket secure, put some packing material from the rocket shipping container under the head of the rocket. Use a ratchet strap to secure the launcher rail with the rocket to the launcher.

Note: The strap must go over the top of the launcher rail, not just over the rocket, to prevent undue stress on the rocket.

Problem. Units travel at excessive speeds over rough terrain. Several line charge misfires at the NTC may have been caused when the charges shifted in the container before they were fired.

Solution. For trailer-mounted MICLICs, maintain speeds of 15 mph or less on improved trails and 10 mph or less when traveling cross-country; the top speed for the AVL M is 30 mph. Leaders must plan for the low speeds and coordinate with their supported maneuver units.

Checking the System

The following checklists for precombat checks (PCCs) and precombat inspections (PCIs) were developed to help leaders ensure that the

complete MICLIC system is combat-ready. The checklists do not replace the PMCS in TM 9-1375-215-14&P.

PCC/PCI Checklist

- Perform PMCS on the armored personnel carrier (APC) or the AVL M.
- Perform PMCS on the launcher.

Notes:

(1) On a trailer configuration, the launcher is connected to the trailer with four U-bolts. The line charge container is fastened with two 6-inch turnbuckles in front and two 12-inch turnbuckles in the rear.

(2) On the AVL M configuration, the launcher is connected with two U-bolts in the rear and two modified U-bolts on the center I-beam. Chain and binders are used to secure the line charge container. The binders must face rearward when closed; secure the binder to the chain with 100-mph tape.

Start the inspection at the top of the line charge:

- Ensure that the rocket is tied down properly and locked into position.

Note: The tie-down straps must be attached to all four hand knobs on the rocket rail guide.

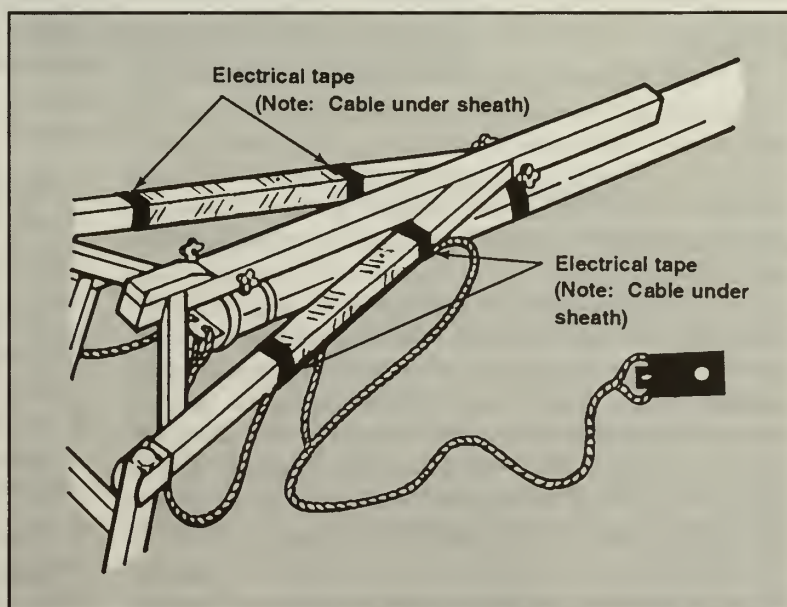


Figure 5

- Give the ball-lock pin for the rocket motor to the crew or secure it to the rocket motor.
- Ensure that both bridle cables behind the sheath have an 18-inch loop in place.
- Lay the bridle cables forward of the sheath on top of the line charge and configure them in an S-curve pattern.
- Place the bridle cables in the sheaths on both sides of the launcher and secure the cables with electrical tape.
- Pull back the nylon sock from the arresting cable fuze connector and inspect the connector.

Note: The electrical firing wire must be secured to the nylon rope opposite the arming wire using ONLY paper masking tape. Do not tape the arming wire.

Move to the rear of the MICLIC launcher :

- Connect the safety switch cable to the tub of the line charge.

Note: Before beginning the continuity check, shunt the rocket receptacle with either a shunt plug or a jump receptacle with a 3-inch piece of communications wire.

- Verify that the hydraulic cylinder will hold from 3200 to 3500 psi and that the control valve is set to the pressure accumulator.
- Engage the detents.
- Ensure that the two ball-lock pins are in place on the rail.

Note: The ball-lock pins must be placed in the RAISE position; however, when traveling, the pins must be in the LOCK position.

- Mount and connect all cables.
- Move to the location where the control box will be fired.
- Verify the continuity check.

Notes:

(1) With the rocket in the down position, set the electrical control box selector switch to SAFE/TEST; hook up the M51 test set and depress the handle; the system should show a light. The system should not show a light when the selector switch is set on ROCKET or CHARGE. If a light is observed on the ROCKET or CHARGE setting, stop and notify the unit maintenance section.

(2) Raise the rocket from the control box and observe if it locks into position. Ensure that white marks on the inner launcher rail supports are visible but have not risen high enough for the vertical white marks (T-strips) to be seen above the outer lower launcher rail supports. Move the selector switch on the control box to ROCKET, and depress the handle of the M51. You should see a light on the test set. Move the selector switch to CHARGE and again you should see a light.

- Place the protective cover on the line charge.
- Rehearse the misfire and evacuation drills.

Prepare for Movement

- Position the electrical control box so that it receives maximum protection yet affords quick access.
- Secure the cable for travel. This is especially important when using APCs with trailers.

Note: The 60-foot cable frequently is damaged when it falls between the APC and the trailer. Run the cable so that it does not interfere with troop reaction to enemy contact. For example, ensure that the cable will not be severed when troop hatches are closed during an indirect-fire attack.

- Place packing material from the rocket shipping container between the line charge and the rocket. Secure with a cargo strap.

Note: The strap will extend from one side of the launcher over the rocket and guide rail. Secure the strap to the other side of the launcher.

- Put the protective cover in place and check the line charge once more.

Notes:

- (1) The bridle cable must be in the S-curve pattern; the protective cover must not interfere with the firing operation.
- (2) The bridle cables must be secured properly.
- (3) The rocket ball-lock pin must be attached to the rocket or be in the hands of the crew.

- Insert the launcher rail ball-lock pins in the lock position.
- If towing the MICLIC, secure the trailer to the APC.
- When towing the MICLIC, maintain speeds of 15 mph or less on improved trails and 10 mph or less when traveling cross-country. The speed for an AVL M should be no greater than 30 mph.

Note: Excessive speed may require that the MICLIC spend more time at the assault position rather than moving quickly forward to fire.

Prepare for Firing

The MICLIC must be prepared for firing before it is moved forward for deployment. This preparation time will minimize soldiers' exposure to enemy contact.

- Remove the ratchet strap and packing material.
- Remove the ball-lock pins from the LOCK position and insert them in the RAISE position slots.
- Pump the hydraulic cylinder until the pressure gauge indicates between 3200 and 3500 psi. Then set the control valve to the PRESSURE ACCUMULATOR position.
- Attach the rocket receptacle cable to the tub.
- Ensure that the detents are in the down position.
- Place the ball-lock pin in the rocket head.
- Move the system forward to fire.

Table 1. Recommended BOM for MICLIC Operations

NSN	Nomenclature	Quantity
6625-01-131-8586	Digital multimeter (fluke)	1
7510-00-198-5831	Tape, masking (roll)	1
5975-00-074-2072	Strap, tie-down	50
5970-00-686-9151	Tape, electrical (roll)	1
4925-00-999-3454	Test set (blasting cap) M51	1
1375-00-567-0223	Blasting machine, M34	2
1670-00-725-1437	Tie-down, cargo	1
(AVLM Only)		
Steel Pole	Cheater pole (for binders)	1
	(Do not use an aluminum pole!)	
	Tape, 100 mph (for binders) (roll)	1

NOTE: The AVLM is considered one system.

References : TM 9-2320-205-14&P M200A1 Trailer
 TM 9-1375-215-14&P w/change #1 MICLIC
 TB 43-0001-36-5 Equipment Improvement Report

Table 2. Recommended PLL Stockage

NSN	Nomenclature	Quantity
5306-01-226-8720	Bolt, U-	4
5310-00-491-5895	- Washer, flat	8
5310-00-937-0453	- Washer, lock	8
5310-00-764-6609	- Nut, hex	8
6150-01-348-4036	Cable assembly, power: W5	1
6150-01-347-8428	Cable assembly, power: W3 60-foot	1
4320-01-072-4918	Pumping unit, hydraulic, hand	1
1055-01-316-7764	- Handle, pump	2
3040-01-218-6145	Accumulator, hydraulic	1
5340-01-230-0093	Pin, quick release	2
5930-01-218-4673	Switch, safety, firing	1
4730-01-342-0587	Cover, protective, rocket launcher	1
4730-01-345-4083	- Shock cord	8
5340-01-248-7962	Turnbuckle: 1.00 x 6	2 *
5340-01-249-0589	Turnbuckle: 1.00 x 12	2 *
5305-00-947-4354	Bolt, hex (Grade 8)	4 **
3990-00-171-9775	Load binder	4 **
4010-00-171-4426	Chain, 14-foot	4 **
5310-01-284-6395	Beveled washer, 1-inch diameter	6 **
5310-01-317-0480	Beveled washer, 3/4 -inch diameter	8 **
5310-01-373-6951	Beveled washer, 5/8-inch diameter	8 **
5310-00-499-3333	Nut, hex, self-locking	24 **

NOTE: * For trailer configuration only.
 ** For AVLM configuration only.

- Simultaneously give the authority to fire both the rocket and the line charge.

Notes:

(1) Valuable time is taken from, or added to, breach time by units trying to make firing the rocket and firing the charge a two-part command. Recommend that commanders give authority to fire both the rocket and the line charge when they order the emplacing engineer to move forward from an assault position.

(2) All supporting units in the battlefield must be prepared for the safety standoff when the line charge detonates.

Table 1 gives a suggested bill of materials (BOM) for MICLIC setup. Table 2 provides a suggested prescribed load list (PLL) for MICLIC operations.

Commander's Challenge

With the information in this article and the applicable technical manual, the commander can ensure that his MICLICs are always ready for employment in a combat environment. (Refer also to *Engineer*, December 1994, page 18.) Your challenge is to instill this knowledge in the leaders and soldiers responsible for this weapon system. Stay abreast of all current guidance involving the MICLIC and conduct appropriate inspections to ensure the maintenance status and mission capability of this valuable combined arms breaching asset.



CPT Birchmeier, SFC Purdin, and SFC Roberts are assigned to Operations Group at the National Training Center, Fort Irwin, California. They are members of the Sidewinder 12 Team, working as company/platoon trainers.



ENGINEER UPDATE

Commercial numbers are (573) 563-xxxx and Defense System Network (DSN) numbers are 676-xxxx unless otherwise noted.

Department of Training and Doctrine (DOTD)

Director Welcomed. We welcomed our new director, Lieutenant Colonel Robert Kirsch, in May 1996. He previously served as executive officer for the U.S. Army Engineer Center. LTC Kirsch may be reached at -4111.

Professional Reading List Revised. The Engineer Center's recently revised Professional Reading List provides a short description of almost 100 books on leadership, the operational level of war, and combat operations at the tactical level. There is a separate listing of books on the history of Army engineers. To receive copies of these lists or to suggest changes to them, write to Dr. Larry Roberts, U.S. Army Engineer Center, ATTN: ATZT-H, Fort Leonard Wood, Missouri 65473. POC is Larry Roberts, -6109.

MOSs 12B and 12F Basic Noncommissioned Officer Courses (BNCOCs) Consolidated. On 16 July, TRADOC approved a plan to consolidate the separate 12B and 12F BNCOCs. NCOs who previously were selected to attend the two courses now will attend a single 9-week course that integrates skills from both MOSs. Effective 1 October 1996, only promotable sergeants will be permitted to attend. Class starts for FY97 are: Class 1-97, 16 October 1996; Class 2-97, 6 January 1997; Class 3-97, 17 March 1997; Class 501-97, 22 May 1997; and Class 4-97, 1 August 1997. POC is SFC Lawrence B. Marks, -4125.

Department of Tactics, Leadership, and Engineering

Engineer Officer Advanced Course (EOAC). The EOAC curriculum and student handbook are available on the Internet. Information also is available about the University of Missouri-Rolla master's degree program and the Engineer in Training and Professional Engineer examinations. The EOAC page is linked to Fort Leonard Wood's Home Page. Direct links in these documents connect the user with an instructor at the Engineer School who can answer questions. POC is CPT Kurt Norem, -5764.

Engineer Personnel Proponency Office (EPPO)

Consolidation of MOSs 81C and 81Q Approved. On 14 May 1996, the Office of the Deputy Chief of Staff for Personnel approved consolidation of MOS 81C (Cartographer) and 81Q (Terrain Analyst) into MOS 81T (Topographic Analyst). Consolidated BNCOC training will begin in January 1997;

consolidated advanced individual training (AIT) will begin in July 1997.

To facilitate reclassification, the Engineer School is finalizing a transition plan that identifies all tasks in which soldiers must demonstrate proficiency. The approved plan will be distributed by September 1996. Soldiers will have until August 2000 to complete transition training through supervised on-the-job training or attendance at either the consolidated AIT or BNCOC. POC is SFC Theodore Mohn, -4087

Directorate of Combat Developments (DCD)

Polygonal-Based Terrain in the Corps Battle Simulator (CBS). The Jet Propulsion Lab is testing a new version of the CBS. The new CBS leaps from the hexagonal-based terrain grid to a more robust and flexible polygonal terrain grid. A major drawback to the hex-based terrain was that players could only emplace obstacles on the hex edge, and the obstacles had to extend the length of the edge. The new terrain model allows players to emplace obstacles at doctrinal lengths anywhere on the map. An operational test will be conducted at Fort Leavenworth in August. The first planned exercise using the new technology is Prairie Warrior 97, scheduled for May 1997. POC is CPT Bill Davidson, -4084.

Engineer Branch Safety Office

Demolitions Accidents. Serious demolitions accidents to soldiers during the period September 1991 through June 1996 resulted in three fatalities and three permanent disabilities. All of these accidents resulted from a failure to follow procedures or a failure to maintain a minimum safe distance, as described in AR 385-63 and FM 5-250. Failure to follow procedures for steel-cutting charges (AR 385-63 and FM 5-250) contributed to two of the engineer accidents (one fatality and one permanent disability). A training packet called "Demolitions Certification" is available from the Engineer School. To receive copies, call SFC Francisco at (573) 596-0071 or DSN 581-0071. POC is Paul Rusinko, -4025.

News and Notes

60-Kilowatt (kw) Generator Operation and Repair Video. A team effort between Headquarters, U.S. Army Combined Arms Support Command Training Directorate (Fort Lee, Virginia) and the Ordnance Center and School (Aberdeen Proving Ground, Maryland) has produced the video "Operation and Setup of the 60-kw Tactical Quiet Generator." The video is intended to help reduce damage to the generator sets. The video, TVT 9-312, PIN No. 710844DA, is available through local Training Support Centers (TSCs). POC is Ed Starnes, (410) 278-2415.



BRIDGE THE GAP

By Command Sergeant Major Julius B. Nutter
U.S. Army Engineer School

Engineer Force Protection

Our regiment has come a long way in its ability to successfully integrate risk management into training and battlefield operating systems. The number of accidents in fiscal year 1995, shown below, reflects our success.

Engineer Accident Summary

Fiscal Year	No. Accidents	No. Fatalities	Cost (Millions)
93	479	9	\$9.7
94	358	11	5.5
95	239	8	6.4

Despite the overall improvement, however, a review of recent training accidents shows a common factor: ineffective risk management.

Risk management is a logic-based, common-sense approach to making calculated decisions regarding human, materiel, and environmental factors before, during, and after every training mission. It enables leaders to maximize their training and operational capabilities while minimizing the risks to soldiers. Risk management is a five-step process that requires all leaders to—

- Identify hazards.
- Assess the risk of each hazard.
- Make decisions and develop controls.
- Implement controls.
- Supervise.

A recent accident involving an M21 antitank mine seriously injured two engineer soldiers. The following information is provided to remind engineer leaders about the restrictions for live-mine training:

- Training is allowed using M15, M16, M19 and M21 mines.
- No training is allowed with live M14 mines.
- All approved mines will be armed/disarmed no more than 25 iterations per mine.
- No trip wires or booby traps will be used.
- Use of tilt rods with live mines is prohibited.
- Training with M16 antipersonnel mines must be conducted with the positive safety pin remaining in the M605 fuze.

- No pre-1957 fuzes are allowed in training with the M16 antipersonnel mine.
- All arming and disarming will be conducted in the prone position.
- Live-mine training and simulator training will not take place concurrently at the same location to preclude a live mine from being mistaken for an inert mine.

Restrictions for live-mine training are contained in the following messages and DA Pamphlet: HQDA, DAMO-TR/DACS-SF, 141237, Dec 90, subject: Live Mine Training; HQDA, DAMO-TRO, 151835Z, Apr 96, subject: Ammunition Prohibited From Use During Training; and in DA PAM 350-38, *Standards in Weapons Training*. FM 20-32, *Mine/Countermining Operations*, provides additional guidance. A basic risk assessment for each of the above mines is in Appendix E of FM 20-32. Units must adapt these risk assessments to account for local conditions.

Human error is responsible for 80 percent of all accidents to Army personnel, including both ground and aviation operations. Accident-causing mistakes occur for a number of reasons. Sometimes the individual who makes the mistake is at fault, and sometimes it is the individual's unit or higher command that is at fault because they failed to provide adequate training, guidance, or supervision.

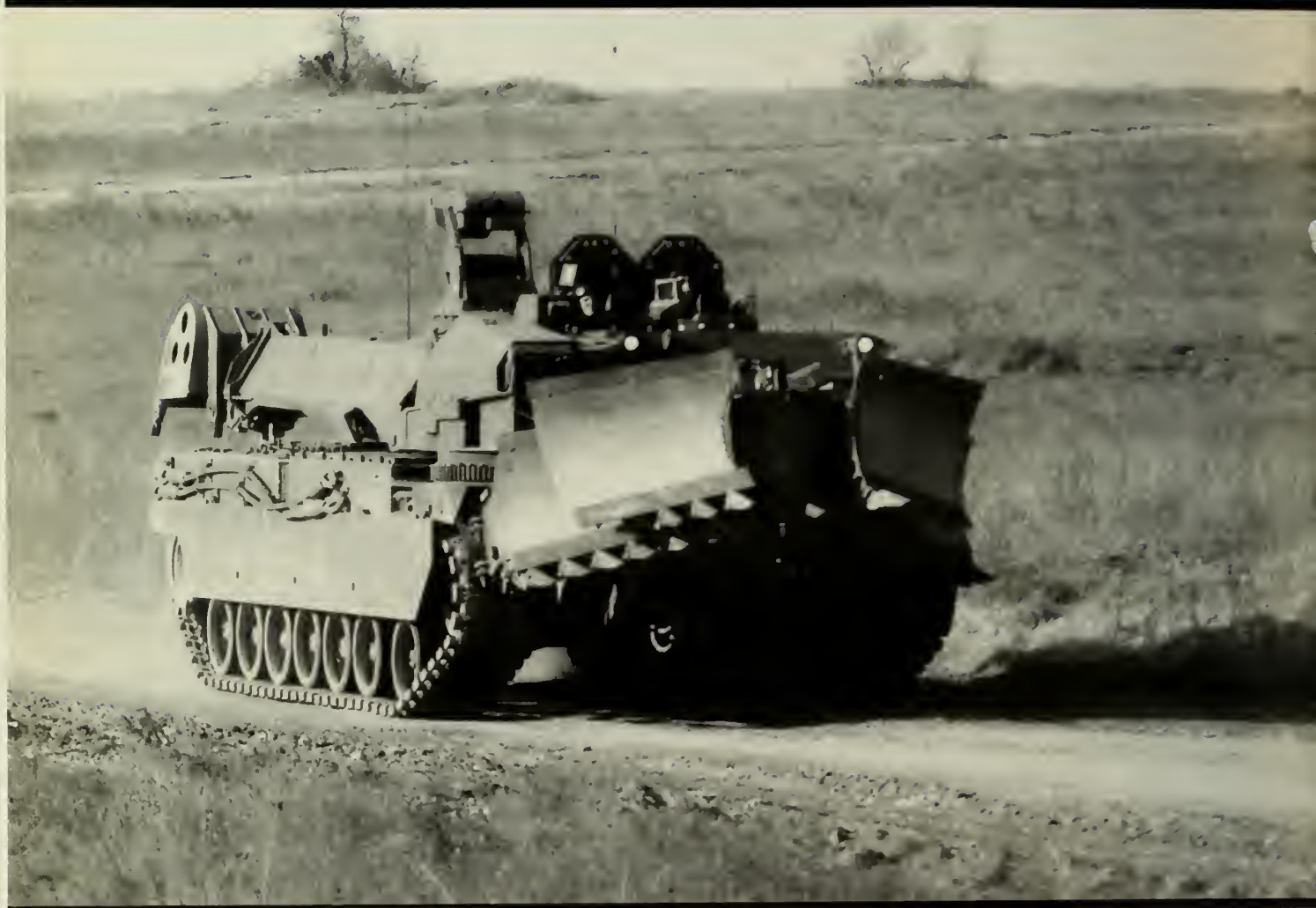
The "Next Accident Assessment" is a good tool all leaders should use to promote accident prevention. It is included in two booklets available at your local safety office and at the U.S. Army Safety Center at Fort Leonard Wood (*Risk Management Reference Guide & Coursebook*, July 1993; and *Leader's Guide to Force Protection Through Risk Management*, October 1995.) The risk assessment is based on the top five reasons for human-error accidents in both ground and aviation operations over the last 10 years. These reasons involve self-discipline, leadership, training, standards, and support.

Safety begins with every soldier. Training safely does not mean unrealistic training. Units can execute realistic training to standards that is challenging and fun. But to train safely, leaders must be aware of the potential hazards and take sensible precautions.

Remember, no single tool or technique can completely protect the regiment. Additionally, tactics, techniques, and procedures applied without disciplined execution will not work. I challenge all noncommissioned officers to protect the force by using risk management in their daily operations and training.

The Grizzly

The Future of Army Engineers



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Engineer

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December 1996



COUNTERMINE

Headquarters, Department of the Army
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CLEAR THE WAY

By Major General Clair F. Gill
Commandant, U.S. Army Engineer School

Land mines cause about 26,000 casualties worldwide every year. Although most of these casualties are the result of the indiscriminate and irresponsible use of mines, they have caused antipersonnel (AP) mines to be severely stigmatized by the international community. As a leader of the "responsible" international community, the United States has chosen to pursue the regulation of AP mines. In setting a standard that we hope others will follow, the President announced a significant change in U.S. policy for AP mines on 16 May 1996. The Army and the engineer community were involved with the Joint Chiefs of Staff in developing the new policy and will continue to be key players in discussions regarding the expanded policy. This new policy affects the way combat engineers will "shape" battlefields in the future. Several articles in this magazine address the countermine challenge. I will discuss the impacts of this policy on the way engineers will train and fight at all levels of conflict.

The "U.S. Anti-Personnel Landmine Policy" announced by the President in May 1996 states:

- The U.S. will aggressively pursue an international agreement to ban the use, stockpiling, production, and transfer of AP land mines.
- The U.S. views the security situation on the Korean Peninsula as a unique case and in the negotiation of this agreement will protect our right to use AP mines there until alternatives become available or the risk of aggression has been removed.
- Effective immediately, the U.S. will unilaterally undertake not to use, and to place in inactive stockpile status with the intent to demilitarize by the end of 1999, all nonself-destructing AP mines not needed to train personnel engaged in demining and countermine operations, and to defend the United States and its allies from armed aggression that crosses the Korean Demilitarized Zone.

This far-reaching policy eliminates the use of M14 blast AP mines and M16 bounding fragmentation mines outside the Republic of Korea. It does not affect our use of self-destructing mines or command-detonated weapons (M18 claymore). The loss of nonself-destructing mines requires that we rewrite doctrine on the emplacement of both tactical and protective minefields. Engineer School personnel are revising the doctrine in FM 20-32, *Mine/Countermine Operations*, to reflect these changes. The regional commanders in chief (CINC) have been directed to remove

nonself-destructing AP land mines from all unit basic loads (except in Korea) and to modify existing war plans to account for the loss of nonself-destructing AP mines. Currently there is no replacement for these mines, although alternative technologies and "nonlethal" weapons are being explored (see article, page 11).

We are reviewing and changing our training strategies accordingly. Because there will be no live M16 AP mine training by units outside of Korea, the authorizations for live-mine training in DA Pam 350-38, *Standards in Weapons Training* (STRAC manual) are being eliminated except for units in Korea. The Engineer School will continue to train initial entry soldiers on inert mines.

As part of the change in land-mine policy, we have been directed to examine ways engineers can help expand demining efforts. Demining is defined as the complete removal of *all* mines and unexploded ordnance from an area after a conflict. It is typically done without the benefit of any existing minefield record. Traditionally, special operations forces (SOF) have conducted most demining train-the-trainer missions. The policy stating that U.S. soldiers will not enter a known, live minefield will not change.

The U.S. goal in demining is to develop a long-term, self-sustaining, indigenous demining program based on training provided by U.S. forces to a foreign government. The U.S. training program includes mine awareness campaigns, setting up national demining headquarters, detection techniques, and demolitions used to destroy mines. U.S. Army engineers may participate in demining operations but probably not in a pure engineer unit. Army engineers generally will participate as part of a combined team of SOF, engineers, and explosive ordnance disposal (EOD), psychological operations, and civil affairs personnel in a train-the-trainer mode.

The Engineer School has been asked to investigate the feasibility of establishing a humanitarian demining operation (HDO) training facility at Fort Leonard Wood. Our Countermine Training Support Center is conducting this study due to their ties to the special operations and EOD communities. If approved and funded, we anticipate that this center will become the nucleus of the HDO training facility. The engineer community must ensure that the military use of AP mines is effectively presented in future political and legislative initiatives.

We will keep you informed about the new mine doctrine, training-policy issues, and demining studies. Engineers must work within this policy and remain a trained force ready to fight our nation's battles.

Engineer

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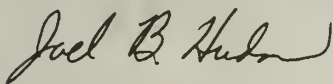
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Front Cover: Countermine technology supports the global effort to detect and neutralize mines and UXO. Photos, clockwise: Mozambique deminer, Afghan soldiers with recovered mines, and U.S. soldiers with minifail in Bosnia.

Back Cover: Battle of Palo Alto. Artwork courtesy Library of Congress.

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expertise for the purpose of enhancing their professional development. Views expressed are those of the author and not those of the Department of Defense or its elements. The contents do not necessarily reflect official U.S. Army positions and do not change or supersede information in other U.S. Army publications. Use of news items constitutes neither affirmation of their accuracy nor product endorsement. ENGINEER reserves the right to edit material.

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The hazards of operations in a mined environment—an M2 Bradley after striking a TMA-3 antitank mine.

Countermine: It's More Than In-Stride and Deliberate Breaches

By Colonel Robert Greenwalt and Major Brigid Ockrassa

Engineers do countermine. It's a key part of the mobility mission, and we know how to do it. Field Manual 90-13-1, *Combined Arms Breaching Operations*, tells the entire Army how to do it. Our equipment may not be very good, but it works and we train the mission all the time, particularly at the combat training centers. So what's the big deal?

Hold on to your Kevlar! The world has changed. Breaching through defended obstacles to allow maneuver forces to close with the enemy is no longer the only game in town.

Since the Cold War ended and peace broke out, the world has discovered that it is littered with mines—about 100 million mines! The United Nations (UN) and our allies are actively engaged in dealing with them. Somalia reinforced the fact that single mines buried in a main supply route can stop traffic—and that many people can bury single mines in a road. Bosnia showed that widespread minefields can stop operations cold, even when no one is actively mining. Mines are ubiquitous and, under the scrutiny of CNN cameras, may impact any military operation. Their impact must be neutralized. The engineer force must move beyond simply breaching minefields.

Lessons From Bosnia

Bosnia is a model of countermine operations in a “peace” environment. Residual mines in that country are a threat to all members of the Implementation Force (IFOR). U.S. actions there have included extensive mine-awareness training as well as extremely controlled troop movements and operations to avoid mine encounters. Engineers working with the former warring factions have mapped and recorded minefield locations and proofed and cleared areas for use by U.S. forces.

The IFOR's role in mine-clearing operations highlights the dangers and frustrations of clearing operations. Details of the demining activities made headlines similar to those produced for the Sava bridging mission. Faithful CNN watchers learned the incredibly low-tech, labor-intensive methods we use to clear minefields—and they became outraged. Although the media hype on the countermine mission in Bosnia has crested, it left a lasting impression. It motivated the American public and Congress to demand better solutions. As is typically American, standards are high and patience is



A United Nations peacekeeper uses a bayonet to probe a minefield along the road to the enclave of Gorazade, just outside Sarajevo in 1995.

low—but the resolve to “fix” the countermine problem has energized the world.

President Clinton, along with Ambassador Albright (the U.S. Ambassador to the UN) and Senator Leahy, have deep concerns about the worldwide disaster caused by residual land mines. In addition to working toward an international ban on antipersonnel (AP) mines, they want to remove residual AP mines that threaten innocents daily. In the policy announced on 16 May 1996, President Clinton directed the Department of Defense to increase its support to humanitarian demining operations.

Once again, engineers find themselves on the cutting edge of a defense issue of national importance: trying to solve the countermine problem. As new types of mines, fuzes, explosives, and emplacement techniques are discovered, the task becomes increasingly difficult. However, we aren’t in this situation alone. The assets of the nation and the world have mobilized and, in a very real sense, U.S. Army engineers are at the hub of this activity.

As a result, your job as an Army engineer will assume a new countermine dimension.

What's the Problem?

“If we can put a man on the moon, why can't we find mines?” This question was asked in congressional committee hearings. If only we could make the ground transparent! It's easy to find the moon because we can see it. The keystone in the countermine arch is detection, and it is extremely difficult. Mines come in a wide variety of shapes, sizes, and materials. The ground is an almost infinite set of soils, moisture, vegetation, and clutter (and much of the clutter is the same shape, size, and material as the mines). Weather plays a significant role. And the enemy tries to fool us. No single technology solves the mine problem—and so far, no combination does either.

In a high-speed maneuver scenario, engineers don't look for individual mines. Instead, we treat the ground with

something like a MICLIC, or use plows or rollers to remove enough mines to pass through, and move on. Less-than-perfect technologies are good enough for this scenario. Unfortunately, as the Army moves beyond a high-speed maneuver focus, engineers must move beyond breaching into areas where technological weakness has significant impact.

Countermining consists of two basic tasks: find the mine, and neutralize it. If we know exactly where a mine is, neutralization is relatively simple. If we don't know where it is or don't know how many mines we may have missed, neutralization is far more difficult. The best detection technology available today has only a 70-percent probability of detecting plastic AP mines. We cannot adequately detect mines along routes at speeds that allow convoy operations. All mine detectors produce too many false alarms (each of which must be treated as if it were a mine). Instead of precise detection, engineers sometimes use breaching techniques to treat an entire area—but those techniques aren't 100-percent effective either. Breaching techniques are extremely destructive and cannot be used in areas where they may damage property or structures.

To put it bluntly, the technology isn't there yet!

Who's Working the Problem?

Before addressing the categories of "players," we acknowledge that there is a long-standing group of professionals in each. The following information focuses on recent changes, activities, and increases to the "team roster."

The Army

When U.S. forces deployed into Bosnia, the U.S. Army Engineer School immediately took steps to send additional countermining equipment to them. We fielded low-risk items that showed definite operational potential, working with the countermining technology base at the Communications-Electronics Command, Night Vision Laboratory Countermining Directorate, at Fort Belvoir. That effort soon was absorbed by the Army Countermining Task Force, which provided additional quick "Band-Aid" type enhancements for countermining shortfalls. It broke through much of the traditional acquisition bureaucracy to get limited quantities of needed products into the hands of our soldiers. A follow-on task for the Army Countermining Task Force is to determine an ideal mix of countermining equipment to support contingency operations.

Joint Services

The entire military community has gained a sincere appreciation for the effects of mines. This was made extremely

clear during Operation Desert Storm, in Somalia, and now in Bosnia. As the following examples show, many groups within the joint structure are addressing parts of the countermining issue.

The U.S. military services work together on the battlefield, and we require joint doctrine to support them. Joint Publication 3-15, *Barriers, Obstacles and Mines*, currently is under revision, and the new version will update the countermining doctrine.

One tangible result of the President's policy statement is the recently formed joint unexploded ordnance (UXO) and countermining working integrated product team (WIPT). This team is tasked to coordinate user requirements and development work across all services. The WIPT defines five categories of users:

- Combat countermining
- UXO site remediation
- UXO disposal
- Humanitarian demining
- Explosive ordnance disposal active range clearance

The WIPT showcases the vastness of the problem. An Engineer School representative is the subgroup chairman, and he articulates the joint services' combat countermining requirements. A follow-on task for the WIPT is to compare the requirements of all five groups, eliminate redundancy, and streamline technical solution sets.

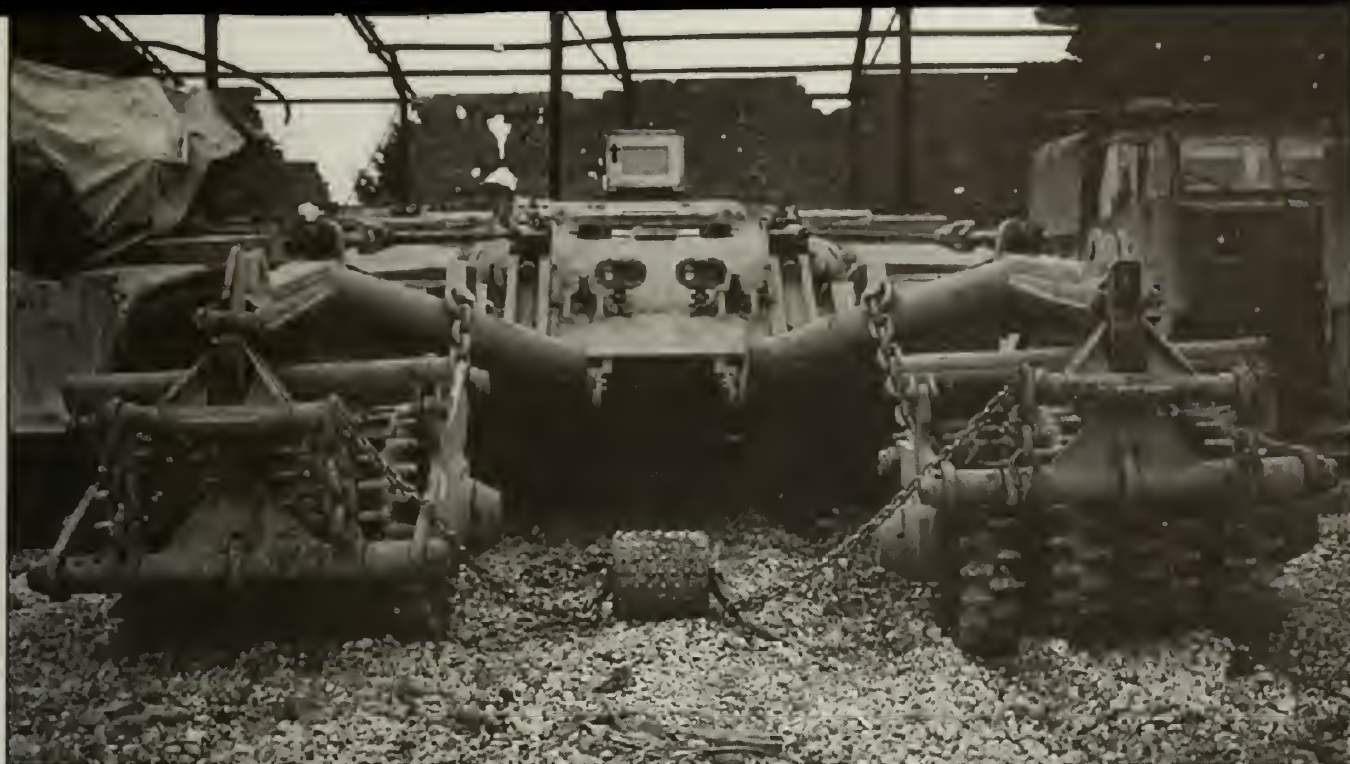
The Defense Science Board focuses a brain trust of outstanding scientists, retired senior military, and captains of industry on defense matters. They are exploring the challenges of UXO remediation. To ensure that recommended products meet user needs, they established a working liaison with the Engineer School. Board members consider mixes of technologies, such as ground-penetrating radar, remotely operated systems, and nuclear quadrupole resonance.

The Defense Advanced Research Project Agency and its advisors in industry and academia, the Defense Science Resource Counsel, and the JASONs address the mine-detection challenge by attempting to artificially replicate the chemical detection process that takes place in a dog's nose.

To promote education and training regarding the mine issue, the Naval Post-Graduate School is hosting a week-long seminar in November 1996 that will showcase working solutions.

Federal Agencies/Private Industry

This is the hardest category to describe because it is so diverse. Unlike most military technological challenges, solutions to the countermining problem have vast federal and



M60 Panther countermine vehicle with track-width mine rollers and improved dogbone assembly.

commercial applications—vast *lucrative* possibilities. Demining is big business. Although profit is a strong motivator, motivations include everything from money to moral responsibility and to simple mission satisfaction.

Among the federal agencies with operational interests in UXO and countermine issues are the Departments of Defense, Energy, Interior, and State; the Federal Aviation Administration; and the Environmental Protection Agency. National laboratories, including those at Livermore, Los Alamos, Oak Ridge, Sandia, and the Savannah River, are pushing the technological envelope to find workable solutions. Potential solutions range far afield—including, for example, genetically engineered bacteria that produce a protein that glows in the presence of explosives. (Don't laugh, it works!). If technology can ensure reliable detection of explosive material, the antiterrorism applications alone would be incredible. Additional missions, less glamorous but necessary, include cleaning hundreds of ranges affected by the Base Realignment and Closure (BRAC) initiative.

Participating private and commercial institutions include numerous defense, environmental, medical, and security contractors. Academic participants include the University of Missouri at Rolla, Duke University, and Ohio State University. Promising developments at these institutions may result in school grants. As their developments produce iterative improvements, everybody wins. Academia is exploring some innovative ideas that may evolve into great successes.

International Organizations

Several international organizations dedicate significant energy to the UXO/ countermine/demining challenge. The cornerstone organization is the United Nations. The UN has

sponsored and financed demining operations worldwide and set the standard for performance and international demining contracts.

A coalition formed by America, Britain, Canada, and Australia (ABCA) has a Countermine Special Working Group that shares ideas, doctrine, and techniques. A countermine subgroup of the U.S./U.K. Staff Talks meets biannually to share data and techniques. The U.S. and Canada share test data and ideas. As a result of the open dialogue and extensive experience of coalition members, participants' understanding of countermine concepts has increased significantly.

The South African Defense Force, which has more than 20 years of active countermine activities, willingly shares its approach to the problem. Their military has adopted an aggressive program to make all military vehicles safe from mines. This program, coupled with unique mine-detection and mine-clearing equipment and a mine-hunting program that includes bounties for mines, has rendered land mines of little value to insurgents in South Africa.

Clearly a strong sense of cooperation permeates the international community. This cross-fertilization is reaping great benefits.

What's the Army Doing?

The Army is gaining a clear understanding of the countermine challenge. A deployed force that conducts operations in a mine-threatened environment is faced with one of two distinct problems: In a combat operation, the force must be capable of free maneuver (maneuver-oriented countermine, where risk is traded for speed). In an operation less than combat, it must ensure there are no mine casualties (a force-protection orientation, where speed is traded for

risk). These problems require different solution sets, and neither is satisfied simply by placing an engineer with an AN/PSS-12 mine detector on the ground.

A significant outcome of Operation Joint Endeavor is the shattered perception that countermine is exclusively an engineer mission. All forces in Bosnia are encountering mines and must "deal" with them tactically. The need for the entire Army to perform missions in a mined environment has expanded the player list to include everyone. This is a mission for the entire force!

TRADOC has chartered a Countermine Integrated Concept Team to develop a holistic concept across all branches, all battlefield operating systems, and all DTLOMS (doctrine, training, leader development, organization, materiel, and soldiers). On the basis of this concept, the team will determine what future operational capabilities must be developed across all DTLOMS and will test them under Battle Lab auspices to determine which should be funded and fielded.

All Army branches must identify how they will operate in a mined environment. They must determine which countermine tasks are so time sensitive that the unit should accomplish them directly, and which require a call for help.

The Army must institutionalize mine-awareness training, as it has NBC training. This includes training for—

- Soldiers—initial entry, annual, and predeployment training.
- Leaders—basic and advanced officer and NCO courses
- Units—the Army Training and Evaluation Program, combat training centers, and field exercises.

The President's policy set the stage for Department of Defense engineers to start planning support to special operations forces in humanitarian demining missions. The current concept has the Army in the lead.

What Happens to the Engineer Role?

While it's too early to tell, it appears that the engineers' role will significantly expand. We understand the need for an extensive mine database in Bosnia and the need for a formal "Mine Action Center" when mines are the major threat to an operation. We require an improved reconnaissance capability. The requirement to keep routes open through sweeping and clearing operations is returning to our mission essential task list (METL). Engineers have other new tasks: answer 911-type calls when units get in trouble, extract wounded, clear mission-critical areas, and resume operations. Additional tasks engineers are almost assured to acquire include assisting with humanitarian demining through reconnaissance, recording, mapping, training, and proofing for quality control.

To assist with these traditional and additional missions, we are on the verge of fielding some exciting technologies

for engineers:

- The Airborne Standoff Minefield Detection System (ASTAMIDS) is due for fielding in 2002, but an early version mounted on a Blackhawk helicopter is almost ready—and an engineer may ride in the back to watch the screen.
- The first prototype ground-penetrating radars that attach to an AN/PSS-12 mine detector were tested this fall. A few may be purchased for use in contingency operations.
- A mine database system that links powerful computers, stores data, and overprints maps to field GPS survey computers will be ready within months. (See article, page 14).

New engineer equipment employed in Bosnia includes remote-controlled tank rollers and miniflails. Mine protective boots used there may become standard engineer field footwear (they work and are extremely comfortable). The Army is purchasing special mine-hardened vehicles for engineer squads working main supply routes and an interim vehicle-mounted mine-detection system. The Engineer School, working with the Army Countermine Task Force and the Deputy Chief of Staff for Operations, is assembling a set of contingency equipment to augment normal unit equipment for the next countermine operation.

The Countermine Training Support Center, recently established at the Engineer School, is developing new tactics, techniques, and procedures for all mine mission areas. This organization will provide mobile training teams to take new technologies to units that deploy to contingency operations.

Better countermine technologies are coming, and they are coming faster than anyone could have predicted even a year ago. In the interim, Army engineers can expect changes in doctrine; in tactics, techniques and procedures; and in organizations. Keep using your mission focus, your Essayons spirit, and the creativity of your soldiers to attack and defeat this problem. Last but not least, send your good ideas to the Engineer School. Together we can win the countermine battle.



Colonel Greenwalt is the director, Directorate of Combat Developments, U.S. Army Engineer School. Previous assignments include chief, Nuclear Division, and weapon's effects officer, U.S. Army Nuclear and Chemical Agency; and chief, Tactics, Training, and Doctrine Division, U.S. Army Engineer School. COL Greenwalt holds a master's degree in National Security and Strategic Studies from the Naval War College.

Major Ockrassa is an action officer in the Directorate of Combat Developments at the U.S. Army Engineer School. She serves on the Army Countermine Task Force, the Countermine Integrated Concepts Team and the UXO Requirements Subgroup of the Integrated Products Team.

Mine Detection Sensors

By Jim Smith

Over the past century, land mines became an inexpensive, effective means to stop enemy movements and demoralize personnel. Deployed and stockpiled, they number in the hundreds of millions. They will continue to pose a threat to soldiers and civilians alike for generations. To combat their threat, countermine efforts have pursued numerous mine-detection approaches. One result is the fielded handheld AN/PSS-12 metal mine detector. The "silver bullet" solution to mine detection has eluded our efforts.

Why is it so difficult to find an

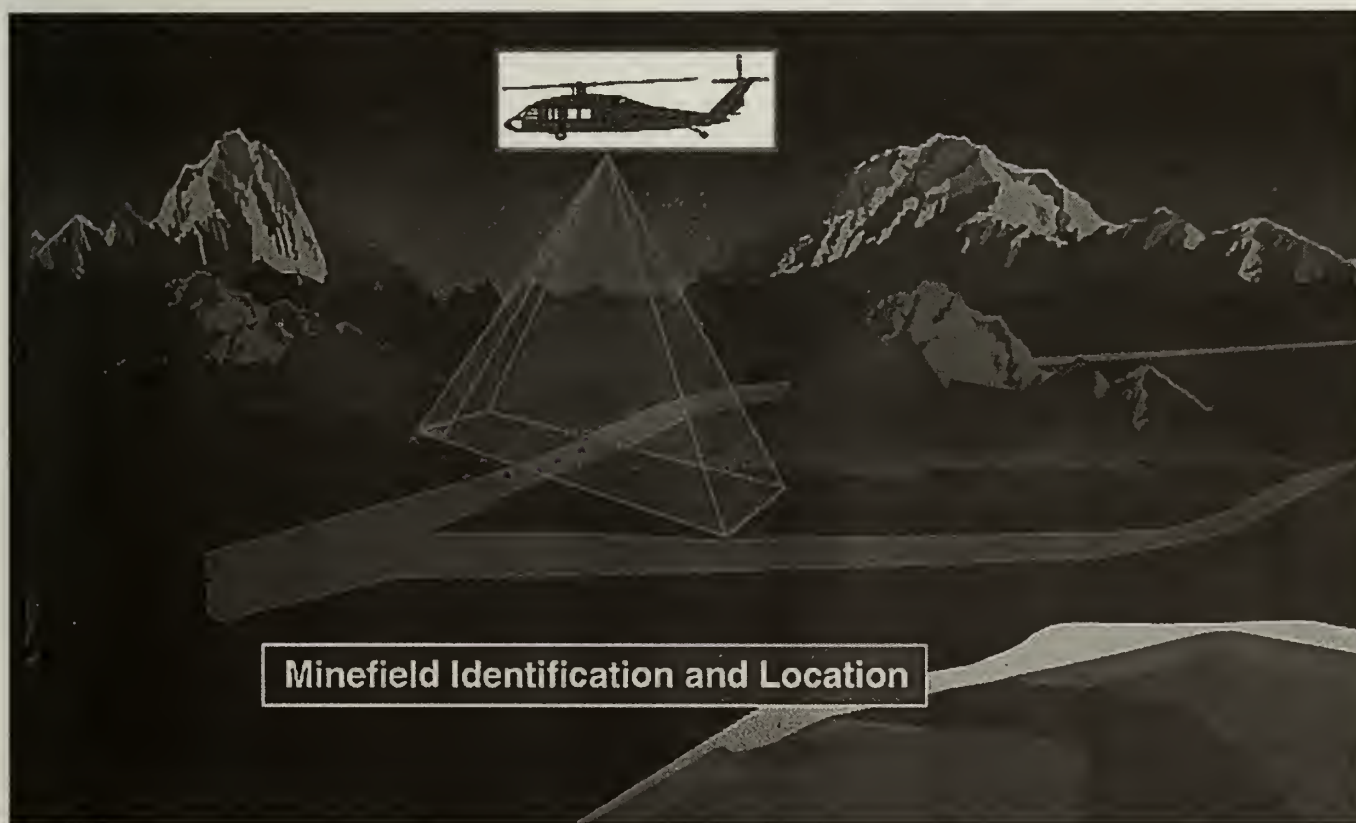
object buried just inches underground? One reason is that Mother Nature provides an endless number of roadblocks in the way of environmental factors that change hourly. Also, mine manufacturers produce an almost infinite variety of mine features such as size, shape, and composition. Their only commonality is the intent to thwart effective mine detection. Technological approaches often fail to meet all of the combat developer's requirements. Often, the solutions are too big, too heavy, or too slow to meet requirements. Finally, countermine

program funding is usually too low and fluctuates with demands for other military equipment.

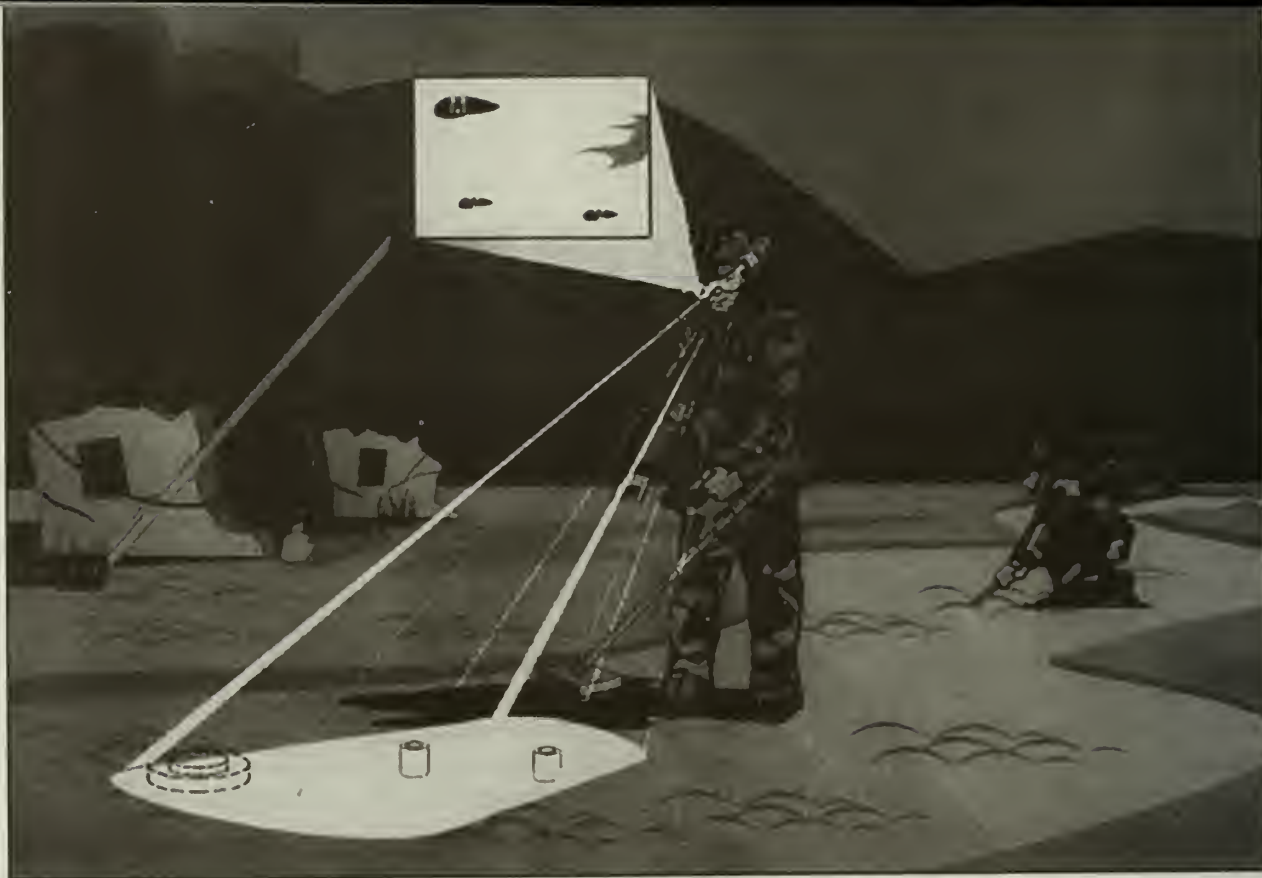
The Defense Science Board of 1987 suggested three technologies with potential to meet the mine detection challenge:

- Metallic detector sensors.
- Ground-penetrating radar (GPR).
- Infrared (IR) sensors.

All three technologies are useful in mine detection, but they have latent limitations that impact the mission. One common point is that none of them is



ASTAMIDS consists of sensors (IR or IR and laser) mounted on either fixed or rotary-wing aircraft and helicopters. Data processing (minefield detection) will occur onboard a helicopter or in a ground control station.



HSTAMIDS is a multisensor handheld mine detector that will replace the AN/PSS-12. The "standoff" sensor is a FLIR. A metal detector and GPR sensors are mounted on a wand similar to the AN/PSS-12.

specifically a mine detector. They are anomaly detectors, because they look for metal, ground density, or thermal anomalies. By judicious use of equipment coupled with visual cues, an experienced mine sweeper can find many (if not most) mines under varying soil, weather, vegetation, and topographic conditions. Of course, there is no perfection in this world, so some mines may be missed. The challenge is to know when and how to use the various sensors for the best results.

Other technologies are emerging from industry, universities, and the government. These will be evaluated for technical potential as well as operational utility, and we will need lessons learned about them. We can assume that each will have some strengths and some weaknesses. Many are so new that it will take years to prove their capabilities.

Our mine-detection capability will improve when the Army fields three emerging Standoff Minefield Detection Systems (STAMIDS). They are—

- Airborne STAMIDS (unmanned aerial vehicle (UAV) or helicopter-mounted) is scheduled for fielding in FY02.
- Handheld STAMIDS (the replacement for the AN/PSS-12) is scheduled for fielding in FY03.
- Ground STAMIDS (vehicle-mounted) is scheduled for fielding in FY06.

A brief description of the sensor technologies used in these systems and how they are fused together follows.

Metallic Detector Sensors

The theory is simple. Although there are different metal-detection technologies (such as balanced bridge and metallic induction), the basic concept remains the same: As the detector head moves over a metallic mass, the detector senses a change in the magnetic field under it. This initiates an audible

signal (and often a visual signal for reduced noise operations), which alerts the operator. By moving the detector head forward/back and left/right, the location can be narrowed to within a few inches. Mine and "coin" detectors share many characteristics, but the capabilities of coin detectors pale by comparison. Today's advanced mine detectors find minuscule metal traces, are hardened for rough field use, and some can be used underwater.

To some extent, metallic detectors are our most dependable workhorses. They are not subject to error from soil moisture and other weather-induced variables. If all mines possessed enough metallic content, metal detectors would be adequate as stand-alone sensors. Unfortunately, mine construction is veering from large, metallic bodies to small, nonmetallic mines. Lightening and reducing mine size decreases the cost, weight, and manpower needed to transport and

employ the mines. Gluing metal onto nonmetallic mines is one answer, but it is expensive and labor intensive. In addition, there is no way to control the mine producers and users to ensure that all mines receive the metal tab. We foresee more nonmetallic mines in the future, because they defeat metallic sensors.

The AN/PSS-12 evolved out of an effort to find low metallic content mines. In use by many NATO and U.N. forces, it proved itself in Operation Desert Storm, Somalia, Haiti, and in Bosnia. Along with its improved maintainability, cheap operation, and interoperability among friendly forces, the AN/PSS-12 detects minuscule metal amounts. However, it has two major shortfalls that are common with all handheld mine detectors:

- It is "look down" only (it must be within inches of mines to detect them).
- It cannot find totally nonmetallic mines.

Finding mines from outside their lethality distance is a critical detection survivability objective.

Ground-Penetrating Radar

The GPR sensor is typical of all radars. It includes two antennae: one to broadcast an active signal through the ground and another to receive the reflected signal that bounces off whatever is in the ground. These bounced-back echoes are plotted to trace the surface texture of the target. Homogeneous soil sends back a flat image, but add a mine and

the picture changes. The mine body, buried in the same homogeneous soil, disrupts the soil density. It reflects an active signal which, in certain radar designs, can actually trace the mine surface much like a topographic map.

One radar developed by the Lawrence-Livermore Laboratory may penetrate the mine housing, search for component planar arrays, and possibly identify the mine by its characteristic planar structure—essentially its fingerprint. This is the high end of advanced radars. To date, it is unproven and requires a detailed mine-construction database.

GPRs are limited by distance from the ground surface and do not work well in conditions of high soil moisture. They work best with aspect angles of "near nadir" (± 5 degrees from the vertical); performance drops off as the angle off



GSTAMIDS is a multisensor vehicle-mounted mine detector. It is in concept exploration with development scheduled to begin in FY98. This concept drawing shows GSTAMIDS mounted on a teleoperated HMMWV. The actual system will be different.

the vertical increases. As such, almost all GPRs can be characterized as "look-down" detectors. This requires the sensor to pass over the mine to detect it. Look-down sensors may accidentally trip the mines, thereby detecting the mine by losing the sensor. Also they are slow because every inch of the mined area must be "viewed." A few emerging "look ahead" GPRs promise increased standoff and detector/crew survivability.

Infrared Sensor

Military forward looking infrared (FLIR) sensors search for thermal anomalies. A FLIR can find an active heat source quite easily. A main battle tank silhouetted against vegetation or clear sky is easily detected, but it is more difficult to differentiate between passive thermal targets. Passive targets are those that receive heat from another source (typically solar loading for mine detection). The ability of an object to radiate its heat is impacted by many factors, including size, construction material, and soil moisture. A metal mine radiates heat at a different rate than a plastic mine beside it, as does the soil on which it rests and vegetation and water nearby. This enables a FLIR to "photograph" a scene from its passive, radiated electromagnetic energy.

On the surface, it appears that a FLIR may make an admirable mine-detection sensor, especially since IR is a true "look ahead" sensor. A camera enables the user to take photos from a distance; this is the same concept—just a different slice of the electromagnetic spectrum. Visible light is 0.4-0.7 millimicrons, short-wave IR is 0.7-1.2 millimicrons, medium-wave IR is 3-5 millimicrons; and long-wave IR is 8-12 millimicrons. Most mine-detection sensors are in the medium- and long-wave IR portions of the spectrum. The

3-5 range works in most areas and reduces the number of false alarms because of its narrower sensitivity. The 8-12 range is more sensitive, but it has a higher false-alarm rate.

IR has technical limitations. It requires solar loading to develop passive heat signature. As the sun moves throughout the day, shadows from trees, buildings, and other solid objects move. This changes the amount of solar loading available to a mined area. Cloudy days lower or eliminate solar loading. Precipitation reduces the dielectric at the soil/mine interface. Any object (such as a rock, beer can, or lost wheel cap) buried in a given soil type has its own thermal signature. Additionally, IR sensors can't "see" through solid objects (such as foliage); they require optical access to mines or at least to the soil over mines.

As the sun rises, mines and their environment soak up solar heat at different rates. During the morning, cold mines show well against the warmer soil. During the evening, warm mines show well against rapidly cooling soil. At full night and around noon, mines and their background environments are at roughly the same temperatures; hence, no thermal signatures.

The FLIR is essentially blind at certain hours, but has excellent vision at other times. Having the flexibility to use the sensors only when they work well makes IR an excellent tool. Unfortunately, soldiers must conduct operations throughout the day and under all weather conditions. The trick is to use IR when it is most effective and plan mine-detection operations around its best target of utility.

Sensor Fusion

There is one important option in using the three sensors discussed in this article: We can take each

sensor's output, combine the best features of each, and process them using a mature algorithm. By processing data from each sensor into an integrated whole, we keep their strengths and filter out their weaknesses. At times, the processor must ignore one sensor and use the remaining two. This sounds easy, but developing complex processors and efficient algorithms is as difficult as developing complex sensor technologies. A few commercial companies entered the market during the early 1990s, and today we have high-speed processors that can handle the huge data influx from the sensors. Companies with in-depth countermining experience are working diligently to improve their sensor fusion algorithms. Algorithm development remains the long pole in the tent for mine detection.

Conclusion

Mine detection is a complex, difficult task we are working to solve. The challenge to materiel developers is tremendous. Combat developers (in this case the Engineer School) often establish stringent operational requirements. Our intent is to provide a family of robust mine detectors that will safeguard the force. Combat and materiel developers are working together to achieve this goal.



Jim Smith is a countermining combat developments materiel analyst at the Engineer School. He has 32 years of military/retired service with nine years of countermining experience. Mr. Smith holds a bachelor's degree in earth science.

Alternatives to Antipersonnel Mines

By Captain Bryan Green

On 16 May 1996, the President announced a new policy that establishes guidelines for the use of antipersonnel (AP) land mines by U.S. forces. (See "Clear the Way," inside the front cover.) The following information describes actions taken by the U.S. Army Engineer School in a vanguard effort to prepare for the 1999 moratorium on mine warfare.

Countermobility Mission Needs

For military forces to meet combat mission requirements and stay within the policy limits, they will require nonlethal AP munitions that support the countermobility mission. These munitions must fulfill the intent of AP obstacles against both combatants and non-belligerents, provide less-than-lethal effects, and preserve the lives of innocent parties.

Munitions that can discriminate between noncombatants and belligerents, such as claymore mines and other man-in-the-loop (command-detonated) systems, are not considered AP mines under the new policy. However, they are discussed as an AP mine alternative in this article.



Photo courtesy Sandia National Laboratories

Sticky Foam

Constraints

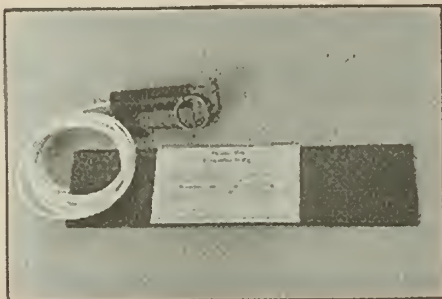
When implemented as prescribed, nonlethal munitions must incapacitate, distract, or contain both nonbelligerents and military forces. While directly affecting personnel and vehicles, they must provide the equivalent physical and psychological deterrents as existing lethal mines but leave no permanent damage or intentional disability. Nonlethal AP munitions also must interface with existing military

vehicles and systems, operate in all types of weather, and be environmentally safe.

Before describing new technologies that may replace conventional AP mines, we must define what these AP mines do. Review of mine-warfare doctrine and conventional uses leads to four basic capabilities:

- Protect other mines (antitank) or obstacles from dismounted forces.
- Provide an economy of force by effectively denying terrain; they

Flash/Bang-Type Munitions



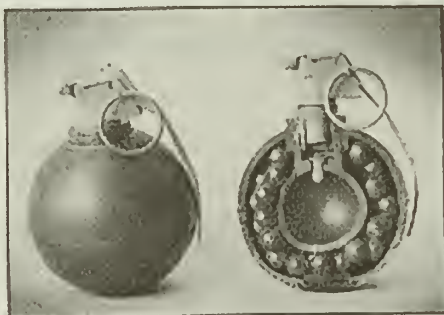
M460 Thunderstrip Stun Munition



Bursting Smoke Grenade



M359 Bursting Obscurant Smoke Grenade



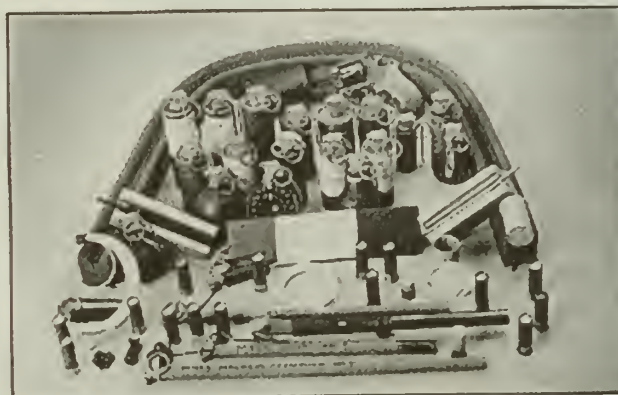
M452 Slingball Stun Grenade



Multiflash Diversion/Distraction Grenades



Rubber Bullet "Slingshot" Ammunition



SPLLAT Munitions

Soft-Projectile Munitions

Various nonlethal antipersonnel munitions that may be used

equate to an additional soldier or sentry on the battlefield.

- Act as a protective obstacle to defeat the enemy's final assault on a position.
- Act as a psychological deterrent.

Any successful AP mine replacement or group of replacements must achieve these four functions. All man-in-the-loop munitions meet these criteria. Command-detonated clay-

mores, for example, allow soldiers to discriminate targets and distinguish between belligerents and noncombatants before detonation. However, many nonlethal options fail to meet the psychological deterrent criteria.

Alternatives

Based on these guidelines, the Army and the Engineer Corps are pursuing alternative non-

lethal man-in-the-loop and tunable (selective-energy/progressive-penalty) munitions.

The countermobility remote-control system (CIRCE) is one man-in-the-loop initiative. It is a teleoperated system of fiber-optic monitors that relays information back to the controller. It allows the operator to decide whether to fire or not. The CIRCE controls conventional mines and effectively makes them command-detonated.

Possible alternative nonlethal munitions

System	Capability
Tasar	Shoots low-voltage darts that incapacitate the target.
Sticky-foam mine	Covers the target with encapsulating foam.
Sting net	Shoots nets that are charged with low-voltage electricity and cover a 50-meter area.
Microwave energy	Beams from a field generator and slowly heats the skin. It gets hotter as the target approaches the source. If the target progresses too far, the heat produces a casualty.
Soft-projectile kinetic-energy munition (Nonlethal claymore mine)	Shoots rubber balls, beanbags, or baton rounds instead of steel pellets.
Water slug munition (tunable munition)	Fires supercharged slugs of water in the autonomous mode or turns to an explosive charge when command-detonated.
Texas boot	Locks or attaches to the foot, immobilizing or limiting mobility.
Embrittling/galvanizing agent (a spray chemical or powder)	Corrodes material or fibers or causes mechanical parts to fuse together.
Radio-frequency-kill munition	Causes a nonnuclear electromagnetic pulse that destroys computers and electronic circuits, effectively stopping vehicles and forcing equipment to be operated manually.
Tessler coil	Creates a harmonic wave that produces a tremor within a 100-meter radius.

Another man-in-the-loop system is the intelligent minefield (IMF). This prototype system will ultimately develop into both an artificial intelligence and a man-in-the-loop automated combat-security outpost. The outpost will employ an array of lethal, nonlethal, and tunable munitions. The IMF probably will control a suite of sensors that can cue fires and command and control elements.

Tunable munitions are systems that

incorporate nonlethal technology. Selective-energy munitions remain autonomous while in the nonlethal mode, preventing casualties or damage to noncombatants. They can be placed in a lethal mode when there is a man in the loop.

Progressive-penalty munitions provide another option. They are designed to temporarily incapacitate both soldiers and noncombatants. These tunable munitions start with a nonlethal

response but progress to an ultimately fatal penalty for continued perseverance in a particular direction.

Some nonlethal systems that the Engineer School is considering for future use are shown in the table above. These are just a few of the alternatives currently being pursued.

We welcome new ideas for AP mine replacements. To offer suggestions, call Captain Bryan Green at the Maneuver Support Battle Lab, DSN 676-7355 or commercial (573) 563-0131, extension 3-7355.



Captain Green is the integration officer in the Maneuver Support Battle Lab, U.S. Army Engineer School. Previous assignments include commander, B Company, 3/10 Infantry Battalion, Fort Leonard Wood, Missouri; platoon leader/XO, 14th Engineer Battalion, Fort Ord, California. Captain Green holds a master's degree in engineering management from the University of Missouri at Rolla.



40-millimeter baton/beanbag/sponge round

Building a Minefield Database System

By Major Edward B. Taylor

The deployment of U.S. forces to Bosnia highlighted an engineer information operations shortcoming. The 1st Armored Division (1AD) Engineer Brigade identified a void in our ability to develop and maintain mine-threat information in an immature theater. Their challenges include fulfilling doctrinal responsibilities as the custodian of the "dirty" battlefield, developing mine-threat information to ensure force protection, and incorporating a solution into existing command and control (C2) platforms that support the maneuver commanders. These commanders require detailed information about minefields and other obstacles during and after hostilities. So how do we track thousands of minefields now? How can we improve the way we track them in the future?

The 1AD Engineer Brigade determined that computer technologies were the appropriate tools to track mines. However, current table of organization and equipment (TO&E) units lack the computer equipment and expertise to build and manage complex databases. Due to

their tenacity and resourcefulness, engineer soldiers in Bosnia are successfully managing this information with an ad hoc organization and database. But their solution is theater specific.

Considering the experience of these engineer soldiers, we must begin now to prepare for the "next Bosnia." We must capitalize on the experiences and recommendations of the 1AD Engineer Brigade to develop a useful set of database tools and a supporting organizational structure.

The Night Vision and Electronic Sensors Directorate (NVESD) of the Communications and Electronics Command and the Engineer School have developed a program to build a comprehensive database system. Between December 1995 and August 1996, their strategy slowly emerged.

Strategy

The NVESD and the Engineer School agreed on a three-phased approach to solve the mine-

tracking problem (see table below). In the near term, we sent a quick fix to the engineers in Bosnia—commercial computers, printers, and software to give soldiers there an improved capability. However, this "Bosnia Band-Aid" is not the solution for the future.

The near future (1 to 5 years) requires an interim system that bridges the gap between Bosnia and Force XXI (Figure 1). It will combine lessons learned from Bosnia with currently known Force XXI requirements. This data will define the operational requirements to create a contingency system for near-term future operations.

Lessons learned from the interim system and related events will provide the framework for the design of the objective system for Force XXI. Both Task Force XXI and the Joint Countermine Advance Concept Technology Demonstration (JCM-ACTD) are likely sources of additional or refined requirements.

The remainder of this article describes the interim system.

Phases of building a minefield database system

Phase	System	Target	Characteristics
Near term	Bosnia Band-Aid	Quick fix	■ Commercial hardware/software ■ Paper maps ■ Current capabilities plus enhancements
Near future	Interim system	Post-Bosnia missions	■ Windows and UNIX systems mixed ■ Bosnia minefield database program
Far future	Objective system	Force XXI	■ Army common hardware/software ■ Digitized Army

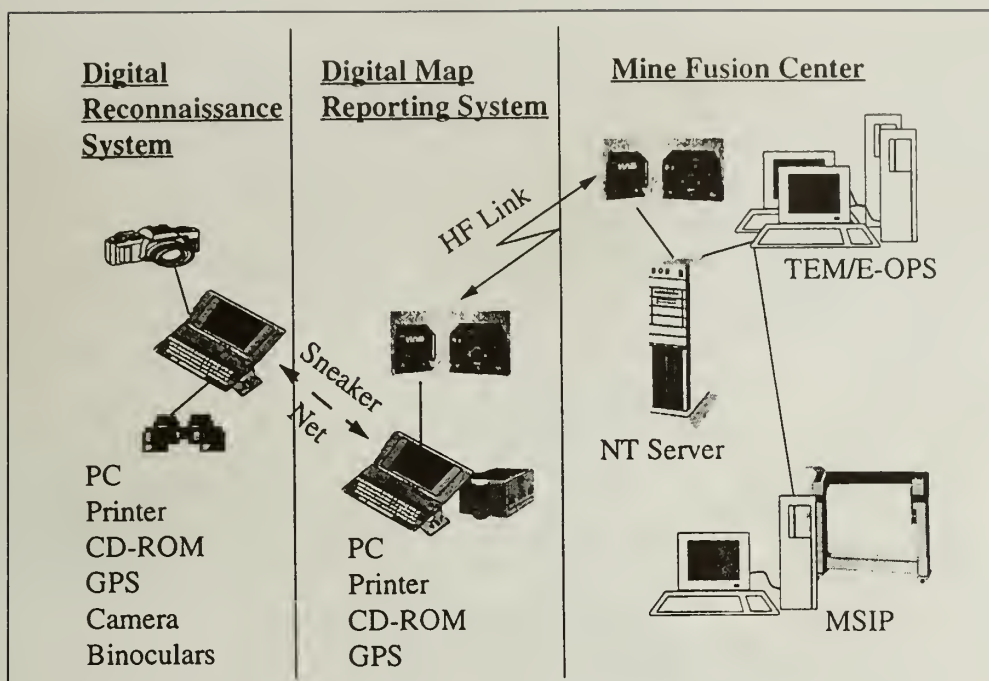


Figure 1. The interim minefield-database system

Mine Fusion Center

The organization charged with collecting and disseminating minefield information in Bosnia is the Mine Fusion Center, which resides at the engineer brigade level. Other United Nations and NATO organizations in theater use the term *Mine Action Center*. In the JCM-ACTD, which is scheduled to begin in the summer of 1997, a similar organization called the *Mine Warfare Center* is under consideration. Regardless of the name, the unit that gets the next Bosnia-type mission should have a minefield information system ready and waiting, with an organization such as these centers provide to operate it. Figure 1 shows the components of the developing system. In addition to the devices discussed below, each system contains both a color and a black-and-white printer, a CD-ROM recorder, and a scanner.

TEM/E-OPS

The Terrain Evaluation Module/Engineer-Obstacle Planner System (TEM/E-OPS), the central database, maintains minefield information and

provides it to other systems. The program developer is the Waterways Experiment Station (WES), a Corps of Engineers Laboratory.

TEM/E-OPS is a prototype of the Tactical Engineer Command and Control System (TECCS) (Figure 2, page 16). Eventually, it will merge into the Maneuver Control System (MCS) as the engineer piece of that system. TEM/E-OPS is a combination of terrain-visualization capabilities and engineer decision-support applications for planning and tracking battlefield operations related to mobility and survivability. It currently runs on a Common Hardware and Software II (CHS II) workstation, which is a Sun workstation that runs a UNIX operating system. Each workstation contains two TEM/E-OPS to provide 100-percent redundancy.

TEM/E-OPS is being enhanced to provide capabilities required by the minefield database program. These enhancements include:

- A database modified to include portions of NATO STANAG 2430, *Engineer Reports and Returns*, and three STANAG minefield-related messages.

- A user interface to modify database entries and attributes.
- Ability to plot minefields with appropriate symbols.
- Ability to export data to the All Source Analysis System (ASAS) and the Multispectral Imagery Processor (MSIP).

Multispectral Imagery Processor

The MSIP will use minefield-database information received from the TEM/E-OPS to produce special digital or paper maps, overlays, or other products that assist battlefield visualization. The Topographic Engineering Center, another Corps of Engineers laboratory, assembles the MSIP.

The MSIP provides an interim capability to generate and print image maps from commercial and national imagery and to perform some terrain analysis of the imagery. MSIP hardware consists of the Common Hardware and Software I (CHS I) workstation. It has several storage devices and one Hewlett-Packard DesignJet 650C large-format printer (it can operate up to three such printers).

The software on the MSIP is Earth Resources Data Analysis System's

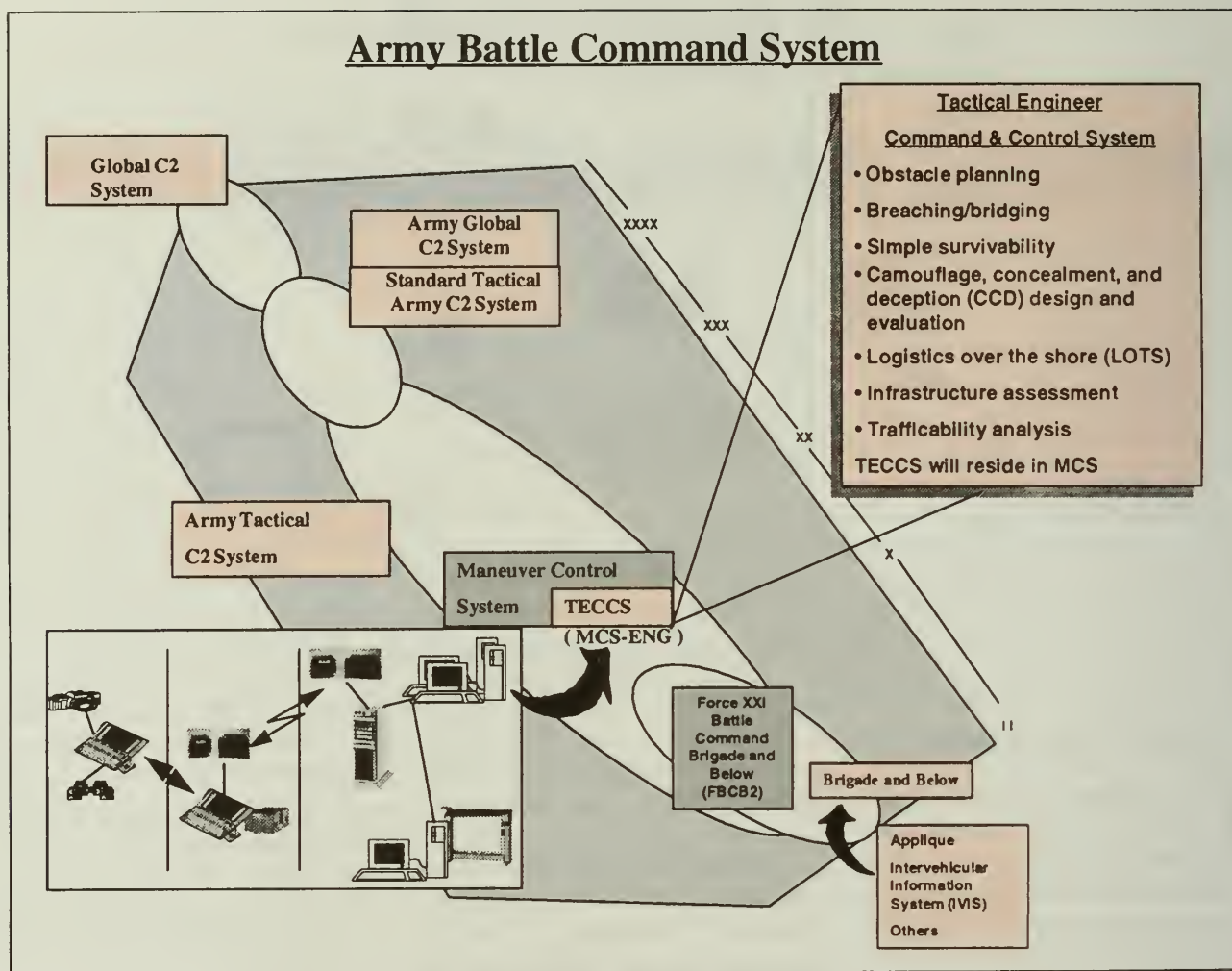


Figure 2. The interim system will merge into the Maneuver Control System as a part of the ABCS

(ERDAS) Imagine, which can—

- Process commercial and national digital imagery.
- Rectify and add grid lines.
- Add thematic layers, intelligence, and environmental conditions overlays.
- Retrieve and use Defense Mapping Agency standard digital databases.

Windows New Technology (NT) Server

Windows NT is an advanced version of the Windows operating system. The Mine Fusion Center's Windows NT server is a temporary storage location for incoming information. The server stores data until it is reviewed, verified, and recorded in the TEM/E-OPS.

The NT server hosts a scanner and a CD-ROM recorder, which allow the Mine Fusion Center to scan minefield records into the database and produce CD-ROMs for bulk distribution to supported units. The NT server also hosts an electronic bulletin board system (possibly Wildcat Navigator) to provide a digital wireless e-mail link between the engineer battalions and the Mine Action Center.

High Frequency (HF) Radio

The NT server has a Joint Internet Controller (JINC) that readily connects with tactical ultra-high-frequency (UHF) radios (such as SINCGARS [single-channel, ground-to-air radio system]) or HF radios. This connection allows the transmission of digital minefield reports or updated minefield information

between the engineer battalions and the Mine Action Center.

Digital Map Reporting System

Operators of the Digital Map Reporting System (DMRS) combine information collected by Digital Reconnaissance System (DRS)-equipped reconnaissance units for transmission to the Mine Fusion Center (Figure 1). The DMRS is used at battalion level. It enables commanders to view data collected by their subordinates before it is transmitted to the Mine Fusion Center. Software being written for the DMRS will allow the battalion to receive minefield data from the Mine Fusion Center and display it on digital maps.

(Continued on page 61)

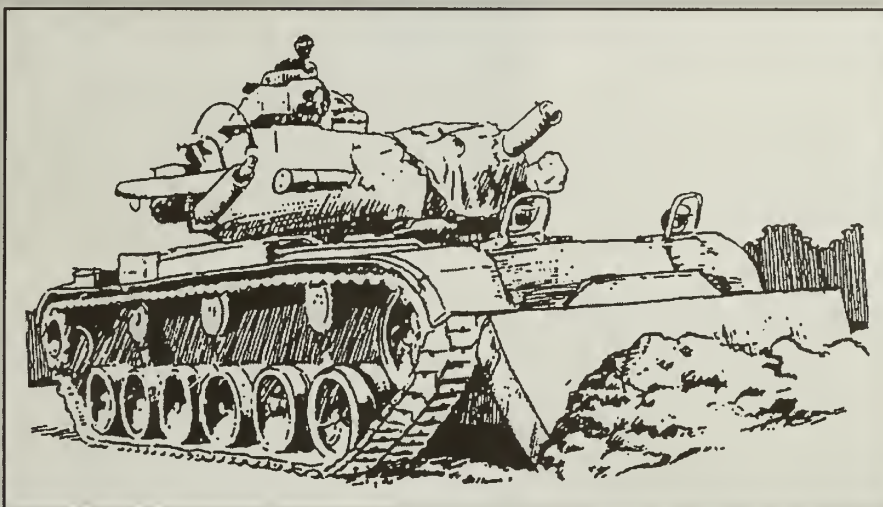
Death of the Combat Engineer Vehicle

By Command Sergeant Major Timothy B. Chadwick

It is official, the Army has declared that the combat engineer vehicle (CEV) will cease to exist throughout the Army inventory. When I heard the news, many emotions ran through me in a split second. I felt relieved of the burden of trying to maintain a piece of equipment based on a chassis system that the rest of the Army had retired. The second feeling was that of disgust—that the leadership of our Army finally agreed with us engineers about how painful maintenance of this system had become.

Several days passed before the last and probably most important emotion hit me head-on. Evidently it took that long to fully digest the impact of the loss of the CEV, without a replacement identified. I can only call this emotion fear. That's right, fear—that we are getting rid of a piece of equipment based on our inability to maintain it and not on an evaluation of its tactical requirement. My fear centers around engineer soldiers of the future and their need for a standoff demolition capability that only the CEV or a like vehicle can provide.

I am fully aware of the Army's research into a 120-mm gun round that will replace or closely resemble the capabilities of the 165-mm CEV round. Can that be done? You bet it can, but my concern doesn't center around the round itself. Why did we look at keeping the gun tube of the CEV so short? I believe that we recognized the need of a turret system for use in tight spaces, such as cities. That tactical possibility exists today and will continue to exist in the future. I tried to



remember how many times I personally saw tanks in urban areas with their gun tubes restricted or even stuck through building walls. I soon realized there were far too many times to count. So, how do we solve this problem in the future? I say that the solution must center around a turret system that resembles the one on the CEV.

I fully realize and agree that the current CEV is too difficult to maintain at the necessary operational readiness rate of our leaner Army. My primary concern remains that mechanical and monetary nightmares overrode our tactical need. Will we need the CEV in the future? You bet we will! I only hope that someone realizes it before a bloody nose forces its replacement.

So ends our love-and-hate relationship with the CEV. To all of the soldiers who manned the CEV, past and present, a hearty "well done!" is in order. You employed and maintained the system to the best of your abilities, and for that you deserve great credit. To the soldiers who employed the

CEV in combat, I ask that you voice your opinions about the need for a standoff demolition capability. Let's not wait for the need to arise in combat before we tell the leadership about our concerns. Soldiers' lives may rest with this lost capability. We must provoke a thorough evaluation of this possible need.

Again, farewell to the single piece of equipment I hated and loved the most of all others during my career.

CSM Timothy Chadwick currently serves as the command sergeant major of the 299th Combat Engineer Battalion (Mechanized), Fort Hood, Texas. He has served in every leadership position available to combat engineers. Previous assignments include three tours with the 7th Combat Engineer Battalion (Mechanized), Fort Polk, Louisiana; two tours in Germany, with the 82nd Combat Engineer Battalion and the 547th Combat Engineer Battalion (Corps) (Mech); and two tours with the 17th Combat Engineer Battalion (Mechanized), Fort Hood, Texas.

Photo-Essay From Operation Joint Endeavor—Part II

By Major Andrew Goetz

Engineers and engineer units must be able to accomplish a wide range of missions, regardless of modified tables of organization and equipment (MTOE). As an engineer observer with Combined Arms Assessment Team (CAAT) II, Center for Army Lessons Learned (CALL) in Bosnia, I found this lesson reinforced most of all. Our current division engineer brigade structure, however, is not designed to accomplish the wide range of general engineering missions asked of it in Bosnia. A large section of this essay addresses my thoughts on the shortfalls of our current structure in the heavy division. I think it's worthwhile to talk about these shortfalls even as we move toward Force XXI. We must identify the capabilities we need. Only then can we design a unit that ensures success in both the high-intensity conflicts for which we must be ready and the Joint Endeavor-type missions that we will surely continue to have.

Base Camp Living Conditions

Much of the base camp construction was complete by the time I arrived in March 1996, and most soldiers were living in relative comfort, with hot showers in almost every camp. The following information shows some of the techniques used to house soldiers in Bosnia.

Brown & Root had the contract for base camp maintenance and upgrades, while engineer soldiers continue to work the force protection mission. The two missions are closely linked and require good coordination at all levels.

Task Force Eagle established a "mayor" in each base camp to serve as the camp administrator. The mayor provides transient housing, coordinates with Brown & Root, and resolves base camp issues as they arise.

Few of the camps are built from the Army Facilities Component Systems standard designs for initial or temporary construction. Most are somewhere in between these two standards and include hardback tents, Force Provider modules, container express (CONEX) camps (often called United Nations container camps), and existing facilities adapted for our use.



(Photo, left)

Tent City 1 in Tuzla Main, the Task Force Eagle headquarters, is the most traditional type of base camp in Bosnia. The dwellings are hardback, general purpose, medium tents with wood floors, sides, and frames. Boardwalks in most camps keep soldiers out of the mud. Task Force Eagle instituted a self-help program, which provides some materials for soldiers to build shelves, load-bearing equipment racks, and other quality-of-life improvements.

The daily ration cycle is A-MRE-A (hot meal; meal, ready-to-eat; hot meal). Most base camps supplement the lunch MRE with soup, bread, and salad or occasionally serve a hot meal. Mess halls are frequently run by or in conjunction with contractors. At Tuzla Main, the mess hall is run by contractors and is in an old Yugoslavian Army mess hall.

(Photo, right)

This photo shows the difficult conditions under which many of the base camps are built. The tracked vehicle is from the 40th Engineer Battalion. The buildings in the background are typical of those in the zone of separation. They are either destroyed or stripped of useful items, including window and door frames.





(Photo, left)

This bunker is at Lisa Base, headquarters of the 2d Brigade Combat Team. The bunker is a standard design developed by the engineer brigade. It must pass brigade safety and construction standards inspections before it is certified as complete.

(Photo, right)

This is Steel Castle, home of the division engineers and division artillery. The engineer flag flies at the 94th Engineer Battalion (C)(H). Steel Castle is a Force Provider camp. Each Force Provider module can support 550 soldiers and is comfortable, with electricity, heat, and air conditioning.

Steel Castle is built on a dirt airfield that is extremely muddy. Gravel has been laid for all of the roads, between rows of tents, and in parking areas. Drainage for this base camp, as for other base camps and the entire area of responsibility, is a major concern for engineer units.



(Photo, left)

The 2d Brigade Combat Team camp is made from military-owned demountable containers (MILVANS) with windows, doors, air conditioning, and heat. The containers are also equipped with beds, sheets, blankets, and towels—just like a hotel. This was the most comfortable camp I stayed in.

(Photo, right)

This view of a container base camp in the 2d Brigade sector shows elevated CONEXes and boardwalks. Off the boardwalks, the mud is two feet deep in places and probably was deeper early in the spring. A similar CONEX camp design links the containers into barracks.



Construction Effort

The primary engineer mission during my stay in Bosnia was construction. Mine-clearing operations in the zone of separation were important, but the construction effort clearly drove the engineer train. In Task Force Eagle, the division engineer brigade was responsible for construction. The 130th Engineer Brigade was on the other side of the Sava River, not in Task Force Eagle's area of responsibility. Division engineers also managed the Class IV construction materials.

To complete their construction mission, the division engineer brigade obtained construction management sections from the 130th, the 94th Engineer Battalion, and the 535th and the 362d Combat Support Equipment (CSE) Companies. Division engineers originally asked for a group headquarters to help manage these corps assets, but that request was not approved.

The construction management section provided planning, management, and quality assurance for the division engineers, and the 94th furnished design work. Both units had the Theater Construction Management System, but problems with the hardware were not resolved during my stay.



(Photo, left)

Constructing parking lots and roads keeps every horizontal asset in country busy. Soil conditions throughout the area of responsibility are terrible, and laying gravel on the muddy subgrade does not solve the problem. Mud percolates through the gravel and causes the structures to fail. The solution is to use geotextile fabrics before laying down the gravel. Since geotextiles are not available through the military system, Task Force Eagle purchased large quantities commercially. We should get these geotextiles a national stock number and maintain them in the supply system.



(Photo, left)

Bosnia's extremely weak infrastructure was neglected during the war, and we have weakened it further. Main supply route maintenance is a major concern throughout the country. The 94th did some paving operations, as shown above and in the next photo. Soldiers in Task Force Eagle filled potholes with gravel, cold patch, and hot asphalt. Much of this work was done under contract and was paid for by either NATO or Task Force Eagle, depending on the route and location.

(Photo, below)

The division engineer battalions are deeply involved with construction. In addition to building bunkers, two-man fighting positions and erecting hardback tents, combat engineers completed projects like the bridge abutment shown here. This abutment is for an armored vehicle-launched bridge (AVLB) on the entrance road to a base camp. The 362d Combat Support Equipment Company provided the heavy equipment, and the Assault and Obstacle Platoon, B Company, 40th Engineers, did the rest. This is a fairly significant project for an engineer battalion with the current force structure.



(Photo, left)

This is another view of the AVLB abutment. Sandbags will eventually cover the structure on the river side to protect it from erosion.

Current Engineer Battalion Strengths and Shortfalls

Operation Joint Endeavor highlights both strengths and weaknesses of the current division engineer brigade structure. The benefits having an engineer brigade commander and staff at the division level and battalion commanders and staffs supporting maneuver brigades cannot be overemphasized. The ability of brigades to receive diverse engineer units and to synchronize their efforts in support of the division is a force multiplier that cannot be replaced by an ad hoc or nonorganic headquarters. The habitual relationship between engineer battalion headquarters and maneuver brigades in Bosnia enhanced staff integration of the brigade combat team. It also allowed engineer company commanders and especially platoon leaders to focus on mission execution. The result is accomplishment of the diverse missions described in this article. The basic structure of the divisional engineer brigade is an excellent starting point for the engineer organization of Force XXI.

Despite the soundness of the basic structure, Operation Joint Endeavor highlights several deficiencies in the organization, equipment, and training of battalions configured under the engineer restructure initiative (ERI). My intent here is not to try and turn back the clock in our structure, change the primary focus from warfighting to peacekeeping, or propose a wish list that our resources cannot support. I understand the manpower and fiscal limitations we must work with. I believe, however, that we must identify our current shortfalls in order to design the best engineer structure for Force XXI.

Operation Joint Endeavor is the first true operational test of the ERI concept. It represents our most likely future operations—peace enforcement (with or without forced entry) into a theater with a poor infrastructure and a focus on force protection. From an engineer perspective, Joint Endeavor is not very different from Operation Desert Shield: entry into a theater without pre-existing U.S. facilities, no immediate combat operations, great demands for force protection, and significant construction requirements.

The primary mission of a division engineer brigade is to provide the force with mobility and countermobility support. I believe that, with some minor changes, division engineers can maintain that capability and provide critical survivability and sustainment support as well.

Maintenance

The maintenance organization in the divisional engineer battalion is not robust enough to support dispersed companies during extended operations. The small contact team attached to the companies from the battalion motor pool is usually headed by an E5 soldier. This noncommissioned officer lacks the maintenance management experience and training required to run company maintenance operations. Maintenance support problems are compounded by the low-density, unique equipment in the engineer company. Class IX requisitions and direct-support jobs for dispersed companies cannot be easily supported by one engineer unit-level logistics system (ULLS) computer. If the company goes through the task force for supplies (which is not doctrinally correct for direct support), then the engineer battalion loses sight of the maintenance status of the company. Maintenance for the small emplacement excavator (SEE) and the armored combat earthmover (ACE) was especially challenging during Operation Joint Endeavor. The two key maintenance leaders in the motor pool—the maintenance technician and the motor sergeant—are both wheeled-vehicle maintenance experts. This doesn't make sense because the pacing items are all tracked vehicles.

Shortfalls	Fixes
■ The E5 soldier in the maintenance contact team lacks maintenance management experience.	■ Add enough E6 slots for each company contact team.
■ One ULLS computer cannot support the companies in a direct-support role.	■ Add three ULLS computers and clerks to operate them.
■ The ratio of one 62B mechanic to 45 pieces of equipment is insufficient.	■ Add 62B mechanics.
■ The maintenance technician and motor sergeant are both trained to maintain wheeled rather than tracked vehicles.	■ Change one maintenance technician to an engineer vehicle maintenance technician.

Construction Management

During Operation Joint Endeavor, division engineers were tasked to manage all in-theater construction, which they accomplished with a construction management section obtained from the 130th Engineer Brigade. Task Force Eagle created the "Base Camp Coordinating Agency" to help manage requirements and priorities for base camp construction.

The construction challenges of Operation Joint Endeavor highlighted our need to develop a frame of mind that recognizes that both "combat" and "construction" engineers must be able to manage construction. This concept should be stressed in the Engineer Officer Basic Course and reinforced in the Advanced Course. In addition, the Combat Training Centers should include this concept in their training.

At the conclusion of Operation Joint Endeavor, the Engineer School should take a hard look at the division engineer brigade staff. Based on input from the 1st Engineer Brigade, they should determine if the staff is robust enough to manage the wide range of operations expected of it.

Shortfalls	Fixes
■ No significant construction management capability exists in the division engineer brigades or in the battalions.	■ Stress construction management in both the Engineer Officer Basic and Advanced Courses.
■ The division engineers obtained a construction management section from the 130th Engineer Brigade. ■ The battalions appointed either a captain or a lieutenant as their construction officer.	■ Determine if the division engineer brigade staff needs to be more robust.

Haul Capability

The current engineer battalion structure does not have the haul capacity to self-deploy on a contingency mission to an austere theater or to conduct extended operations. The motor pool cannot break its prescribed load list (PLL) into separate trucks to send to dispersed companies. This capability is a key requirement for low-density equipment for which the task force does not carry PLL. The motor pool has extremely limited Class IV haul capability in a theater where the demand for Class IV material drives much of the engineer mission.

Shortfalls	Fixes
■ Engineers cannot transport all MTOE and tables of distribution and allowances (TDA) materiel. ■ Engineers cannot transport Class IV unit basic load (UBL).	■ Add six dump trucks to the engineer battalion's support platoon.
■ The motor pool cannot haul its PLL and tool room or disperse PLL to the companies.	■ Add two 5-ton cargo trucks to the support platoon for use by the battalion motor pool.

Earth-Moving Assets

Because soil conditions are poor in Bosnia-Herzegovina, earth-moving assets are in great demand. The only asset organic to the division engineers is the ACE. It does many things well, but it cannot move dirt like a D7 Dozer. The division engineers have no equipment to haul gravel and sand. Earth-moving and fill materials were both in demand early in the deployment.

Demands on corps construction units were heavy throughout the first several months. The units could not provide all of the support required by the maneuver brigades. If engineer battalions had earth-moving and fill capabilities, they could provide much more support to the maneuver brigades. As it is, the battalions have little to offer from their organic assets.

Shortfalls	Fixes
■ Division engineers lack construction earth-moving capability. ■ Corps construction units could not fill the immediate earth-moving needs of maneuver units upon forced entry.	■ Replace two ACEs with D7 Dozers and lowboys in each engineer line company. If this is not possible, add at least three D7 Dozers to the battalion support platoon.
■ Division engineers have no dump trucks to move even limited amounts of fill.	■ Add four to six dump trucks to the battalion support platoon.

Carpentry Skills

In Bosnia, 12B engineers built protective bunkers and wood fighting positions, repaired buildings, and erected hardback tents, all requiring carpentry tasks that are rarely practiced in currently structured engineer battalions. Maintaining basic competence in these skills is not difficult, and engineers in Bosnia relearned the skills quickly. The main hindrance was a lack of power tools. While I do not promote bringing back the old pioneer tool trailer, I do promote putting some key power tools in a platoon carpenter's box.

Shortfalls	Fixes
■ Some deploying units did not train on carpentry skills needed in Bosnia.	■ Recognize that carpentry remains a 12B mission, even in currently structured battalions. ■ Use self-help and post projects to maintain a minimum level of carpentry skills in the unit.
■ Carpentry boxes had essentially been banded and stored. ■ Lack of power tools diminished the 12B construction capability.	■ Field a platoon carpenter's box with two skill saws, two power drills, and two electric nail guns.

Class IV Management

As is frequently the case, engineers in Operation Joint Endeavor were given the mission of managing Class IV construction materials. This was a major logistical planning and management challenge as well as a material-handling and transportation challenge. As part of the Class IV management mission, engineer companies assumed responsibility for running the Class IV storage yards. While engineer battalions have one forklift, which is usually old and difficult to maintain, engineer companies have no material-handling equipment. Engineers had to borrow the equipment needed to manage stockpiles of lumber, wire, and geotextiles. Since they were the primary users of Class IV materials, transportation of the materials also fell to them. As currently structured, battalions are light in haul assets just as they are in material-handling equipment.

Shortfalls	Fixes
■ Engineers were responsible for Class IV management.	■ Assume that engineers have the Class IV construction material mission. ■ Fill the division engineer brigade S4 or assistant S4 slot with a multifunctional logistics officer.
■ Units lacked sufficient material-handling equipment.	■ Field one SEE forklift attachment to each engineer company. ■ Replace and/or maintain the battalion forklift.
■ Units lacked sufficient haul capability to move Class IV materials.	■ Increase the haul capacity of the current engineer battalions.

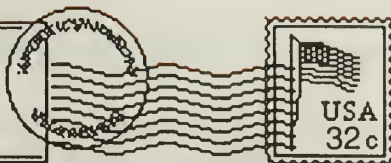
Conclusion

I realize that we don't have the resources to do all the "fixes" in the accompanying charts. However, the capabilities that those fixes represent are ones that we must consider as we move toward Force XXI. As our missions diversify, we must break the recent trend of limiting the division engineer brigade to offensive operations. As our missions become more diverse, our capabilities must keep pace. When the maneuver commander needs engineer work, be it breaching a minefield or building a base camp, he expects his engineers to be able to do it. We must ensure that he can.



Major Goetz is attending the Command and General Staff College at Fort Leavenworth. Previous assignments include construction branch chief, U.S. Army Engineer School, Fort Leonard Wood, Missouri; company commander, 82d Engineer Battalion during Desert Storm; maintenance detachment commander, 3rd Engineer Brigade, 3rd Infantry Division; and military observer to the U.N. mission in the western Sahara.

Letters to the Editor



The Engineer School: Providing Lessons Learned to the Force

I would like to respond to your discussion of mine awareness training for units deploying to Operation Joint Endeavor (*Engineer*, August 1996, page 12).

The mine awareness training conducted for units deploying to Operation Joint Endeavor before January 1996 was developed independently by both the engineer observer/controller (O/C) teams at the Combat Maneuver Training Center (CMTC) and by the 130th Engineer Brigade. The 16th Engineer Battalion's training plan (developed with assistance from the Engineer School) was used to train many of the corps assets and some of the divisional combat service support units at Graf and at the home station. However, the majority of the maneuver and combat support units in the brigade combat teams were trained using the CMTC mine-awareness program.

The mine-awareness training that has been and is currently required for all individual replacements and new units deploying to Operation Joint Endeavor was developed by the engineer O/Cs at CMTC. Well over 14,000 soldiers have been trained since we started Individual Replacement Training (IRT) at CMTC in December 1995. In September 1996, we trained an IRT Mobile Training Team (officers and NCOs from the 130th Engineer Brigade) that deployed to Fort Hood, Texas, to train more than 500 engineers from the 62d Engineer Battalion. That training ran from 1-10 October.

The two programs are similar in content and are generally based on information in FM 20-32, *Mine/Countermine Operations*, FM 90-13-1, *Combined Arms Breaching Operations*, and the *Engineer Contingency Handbook*. The CMTC version also incorporates lessons learned from the Canadian and British armies and others. Since the deployment, we continue to update the instruction with lessons learned from Task Force Eagle, observations from O/C trips down range, and other sources.

The following NCOs from the Grizzly Task Force O/Cs were instrumental in developing and executing mine-awareness training at CMTC: SFC James Scher, MSG Herman Wells, and SFC Carlton Young. They did a great job with a difficult subject, and according to the feedback of the soldiers we trained it was "... the best training we ever had..." and "...a real eye opener..."

CPT Scott C. Johnson
Engineer Company O/C, Grizzly 15
Combat Maneuver Training Center

For Your Information:

The CMTC Individual Replacement Training is a three-day program that includes country orientation, media awareness, rules of engagement, negotiations, environmental threats, convoy operations, mine awareness, countermine, situational awareness (checkpoint operations), and force-protection classes. For each class, we also detonate a live M15 mine under a military vehicle to show the effects of a mine strike. Classes usually have about 120 students.

The Air Force has a one-day class at Ramstein, Germany, that selected individuals attend. I know they cover mine awareness, but I have never seen the program of instruction or talked to anyone who attended the class.

Author's reply:

I did not intend to slight CMTC's great efforts in training the force in mine awareness. Their success is demonstrated in the low casualty rates that Task Force Eagle has sustained from mines. My point was only to illustrate that when necessary the Engineer School is capable of supporting the field directly with subject matter experts. The school never sought to supplant the efforts of CMTC, only to assist with the training "surge" that is a normal part of any contingency operation deployment.

MAJ David Brinkley

Maintaining the MICLIC

The article entitled "Maintaining the MICLIC" in the August 1996 issue of *Engineer* was very informative and gave us insight into practices and problems associated with the use of the system in the field. This office is responsible for managing the system, to include the end item, and for supply, maintenance, and publications for all Army applications. Input such as yours can be very beneficial to us.

On page 45, the article specified using a ratchet strap to secure the launcher rail with the rocket to the launcher. We agree with the information in the paragraph except for the use of the ratchet strap. This could easily cause the rail to be distorted, thereby causing a problem with the launch process.

If the crew thinks it is necessary, tie the launcher to the front of the line charge container rail with four interconnected bungee straps. Pages 2-74 and 2-75 of the draft TM 9-1375-215-13&P give detailed instructions. (Please note that the revised TM has been changed from a -14&P to a -13&P manual).

In response to another inquiry, this office prepared a point paper regarding several other problems mentioned in your article.

Thank you for placing this office on the *Engineer* mailing list. In the future, closer coordination with our offices may be of mutual benefit.

Denise Springmeier
Chief, M60/FOV, Mines
Armor Product Center

Author's reply:

We are pleased that Ms. Springmeier had an opportunity to read the article and that many of the issues brought up in the article are incorporated into the new TM that will be published in the near future. Although we do not disagree with using bungee straps instead of cargo straps, I will say that in the past two years the National Training Center (NTC) has not had a problem associated with using cargo straps (the NTC launches up to four MICLICs per month). This article was written as part of the NTC's attempt to reverse identified trends with this equipment. We appreciate the fact that Engineer was able to get this information quickly to the force and that it also was seen by the people responsible for managing the MICLIC system.

CPT Joe Birchmeier

Leading the Way Together:

New Doctrine for Joint Engineer Operations

By Lieutenant Colonel John P. Paczkowski

Much has been written in this magazine and elsewhere concerning the need for better doctrine governing joint engineer operations. I am pleased to report that we have made considerable progress in this regard during the past 12 months. With input obtained from a broad cross section of the joint engineering community, we have reached consensus among the flag officers responsible for engineering in the Army, Air Force, Navy and Marine Corps. More significantly, the Director for Logistics (J4) of the Joint Chiefs of Staff (JCS) has endorsed the need and will be the principal sponsor of the effort to move proposed changes through the doctrine-development mill.

We are on the threshold of an intensive effort to craft new doctrine for joint engineer operations. Therefore, it is important that military and civilian engineers at all levels of each service understand the forces driving these changes and the direction in which the new doctrine is heading. We can argue details within our own community, but we must all "sing from the same hymnbook" as we actively promote these ideas to the commanders we serve and our counterparts in other combat and service support functions.

The following paragraphs describe the joint service team's efforts to define the need and set the wheels in motion for development of the new doctrine. That information is followed by key portions of the white paper prepared by the team. The white paper defines the terms of reference for the service, Unified Command, and Joint Staff engineers involved in moving the issue forward.

Background

In February 1993, the Joint Staff J4 commissioned the joint Engineer Interoperability Working Group (EIWG), which is composed of senior engineers from each of the four service headquarters. An outgrowth of experience acquired in the roles and missions review, the EIWG is an ongoing forum to identify and initiate actions that address issues pertaining to interservice coordination and interoperability. An early priority of the working group was the perceived need for better JCS guidance on the conduct of joint and combined engineer operations.

In September 1993, the EIWG prepared a draft standing operating procedure (SOP) for contingency engineering staffs as a way to bridge the gap in joint doctrine. Unfortunately, the draft was not well received by reviewers. It was seen as being too prescriptive, "in the weeds" regarding staff organization and procedures, and did not adequately address the lack of overarching engineer doctrine. Given this reaction and the pressure of other business, the doctrine initiative was put on hold. The EIWG revived it in June 1995 when, as a working group member, the director of the Navy's Seabee Programs Office (OPNAV-N446) requested assistance from the Naval Reserve Contingency Engineering Programs (NRCEP).

Making It Happen

The NRCEP began organizing an EIWG subgroup for joint engineer doctrine in September 1995. Although it had no fixed organization and membership varied with time, the subgroup eventually included about 40 military and civilian engineers, who represented a cross section of the community. Members included both active duty and reserve personnel from staffs of the commanders in chief (CINC) of the regional commands, major component and service headquarters, doctrine centers, and engineer schools. With limited ability to meet due to distance and travel costs, the subgroup functioned as a "virtual" team with most interaction occurring via e-mail and fax. The subgroup's work was accomplished in five phases.

Phase I - Organization and Research - Potential "stakeholders" were contacted in September and October 1995 to invite their participation in the effort. Background information concerning the issue along with the names of people who might provide valuable input were solicited. Initial service and CINC positions regarding the need for doctrine were assessed, and potential "hot button" issues were identified. Command directives, articles, white papers, after-action reports, and lessons learned were collected, reviewed, and circulated to team members.

“We are on the threshold of an intensive effort to craft new doctrine for joint engineer operations.”

Phase II - Defining the Problem - Based on data gathered in Phase I, the subgroup planned a meeting to define the joint doctrine issue and determine a shared strategy for succeeding steps. The two-day session was conducted in December 1995 at the headquarters of the Naval Facilities Engineering Command in Alexandria, Virginia. A key product was an outline for a white paper that would become the primary vehicle for gaining interservice agreement and communicating the issue to a broad audience.

Phase III - Building Consensus - The work of the subgroup, including the initial draft of the white paper, was presented at the Joint Engineer Conference in Norfolk, Virginia, in February 1996. The presentation generated considerable discussion on the need for joint doctrine and culminated in several well-attended breakout sessions. These sessions dealt with doctrine and related issues, such as training for joint engineer operations, joint engineer planning systems and procedures, and environmental management.

Phase IV - Winning Executive Commitment - With input gained from the conference, the subgroup revised the white paper and issued the final copy in mid-May 1996. This paper formed the basis of a briefing on joint engineer doctrine and training issues to the Engineer Interoperability Review Board in late July. Chaired by the Joint Staff J4, the Review Board provides executive oversight for the EIWG; it includes flag officers from each service with engineering responsibilities.

At the conclusion of the July briefing, the Review Board unanimously agreed to advance a proposal for new doctrine to the J7 (Operational Plans and Interoperability Directorate), with the J4 electing to be the sponsor. The Army, through the Engineer School, accepted the task of shepherding the proposal through the JCS review process. The Navy, through the Naval Facilities Engineering Command, agreed to formulate a proposal for broad-based education in joint engineer operations, as recommended in the white paper.

Phase V - Gaining Joint Staff Approval - In late August, the J4 transmitted the proposal for new doctrine to the J7. This action also added the proposal to the agenda for the biannual Joint Doctrine Working Party (JDWP), held on 22-23 October. Coordinated by the Joint Warfighting Center at Fort Monroe, Virginia, the JDWP includes representatives from the service headquarters and the CINCs, who review proposals for changes to joint doctrine.

Prior to hosting the JDWP, the Joint Warfighting Center

conducted a front-end analysis to assess justification for the proposed changes and recommend actions to be taken by the JDWP. The front-end analysis, completed on 3 October, recommended that new joint engineer doctrine be developed. Following extensive lobbying by members of the subgroup, the J4's engineer staff presented the doctrine proposal on 22 October.

Based on the presentation by the J4 engineer staff and the favorable recommendations presented by the Joint Warfighting Center, as reflected in its front-end analysis, the JDWP recommended development of new overarching joint engineer doctrine. In addition, the JDWP endorsed placing this publication in the “3” (operations) series. This important decision recognizes the broad span of engineer functions in support of operations. As such, it begins to resolve problems that often result from type-casting engineering as primarily a logistics function at the joint force level.

Next Steps

With JDWP approval in hand, the J7 will soon issue a directive assigning the Army as lead agent and TRADOC as the primary review authority (PRA). As PRA, TRADOC will coordinate the joint service doctrine-development effort, with the Army Engineer School in direct support.

With TRADOC and the Army Engineer School poised to take the lead, the work of the EIWG subgroup on joint engineer doctrine is complete. However, the EIWG and the Review Board will continue to monitor progress until a new publication is fielded, probably within the next 18 to 24 months. I encourage you, particularly those of you with experience in joint and combined operations, to step forward and “lead the way” by contributing to this endeavor as it gains momentum over the coming months.



Lieutenant Colonel Paczkowski, a contingency engineering planner assigned to the Installations and Logistics Branch, Headquarters U.S. Marine Corps, is the Marine Corps liaison to the staff of the Director, Naval Reserve Contingency Engineering Programs. He previously served as a Marine advisor to the Reserve Naval Construction Force and as the force engineer, Fleet Marine Force Europe. Lt Col Paczkowski chaired the EIWG subgroup on joint engineer doctrine and is primary author of the subgroup's white paper. He holds a master's degree in management engineering from New Jersey Institute of Technology.



The Need for Joint Engineer Doctrine:

Excerpts from a white paper by the joint engineer community

Edited by Lieutenant Colonel John P. Paczkowski

The absence of a well-developed program of joint doctrine for contingency engineering threatens the effective employment of forces and needlessly increases the costs and risks inherent in joint and multinational operations.

The Issue

Diminishing resources, reduced force structure, and an increasingly complex geopolitical environment have placed demands on the U.S. military to improve the effectiveness of joint and combined operations. In response, the Joint Staff, Unified Commands, Component Commands and service planners are revising joint and service publications, operations plans, standing operating procedures (SOP), and training programs to reflect these realities. Unfortunately, development of comprehensive joint contingency engineer doctrine and its integration with other joint and service doctrine have not kept pace with these reforms.

The fundamental role of engineering in support of joint and combined operations is not receiving a level of attention and focus consistent with its importance. As a con-

sequence, the full potential of engineering as a critical element of operational maneuver is not fully exploited and sometimes is taken for granted by senior combatant commanders. Consideration of key engineer functions critical to mission success is often absent from senior-level decisionmaking. This absence sometimes hampers engineer staff actions and inhibits effective planning, task organization, and the synchronized employment of engineer resources by joint or combined forces.

Genesis of Contingency Engineering

In the early 1980s, European Command (EUCOM) concluded that an all-out confrontation with the Warsaw Pact would cause keen competition within the joint force for engineer resources and that a mechanism for interservice coordination and setting priorities would be needed. Accordingly, they designated the dominant service in each EUCOM region as Regional Wartime Construction Manager (RWCM), with responsibility for coordinating all U.S. military construction in that region. By CINC directive, each RWCM was

to augment its engineer staff with representatives from other services as needed to meet its responsibilities.

As the Cold War came to a close, the U.S. military turned its attention to limited intensity conflicts and military operations other than war (MOOTW). The phrase *wartime construction management* was replaced with *contingency engineering management* to reflect the broader role of military engineering from peacetime contingency to war. The U.S. Central Command (CENTCOM) employed contingency engineering management during the Persian Gulf War. Lessons learned from that conflict and lesser contingencies since then led to contingency engineering initiatives by the other regional CINCs. Today, contingency engineering is viewed within the engineer community as the overarching concept for coordinating joint engineer operations. However, these concepts are not yet fully developed or incorporated into doctrine.

The Critical Role of Engineering

When its full range of capabilities are employed, military engineering can be

a significant force multiplier for the combatant commander. It aids overall success by shaping to best advantage a variety of conditions under which military operations must be conducted. In particular, the contingency engineering concept ensures that maximum benefit is obtained from the engineer assets available.

Military engineering provides support to the intelligence and operational planning efforts by analyzing the effects of terrain, hydrology, and infrastructure, and identifying potential targets. It speeds force flow by assessing shortfalls and improving needed facilities, including air and sea ports of debarkation, force-beddown sites, and lines of communication. Military engineering also provides associated facility operation and maintenance and fire-fighting capability. It facilitates operational maneuver and force protection by providing bridging, expeditionary airfields, facility war-damage repair, explosive-ordnance disposal, barriers, and defensive fortifications. Military engineering also plays essential roles in disaster recovery and humanitarian relief operations, environmental compliance and mitigation, and chemical and biological wide-area decontamination.

The importance of military engineering spans the continuum from the strategic to the operational to the tactical levels of war, and the focus of the engineer effort varies accordingly. The CINCs are primarily concerned with the overall deployment of forces in the context of theater war plans. Thus, engineering at the strategic level tends to focus on major facilities, theater-wide construction management policy, and the allocation of scarce engineer resources. At the other end of the spectrum, tactical-level engineering

“To fully exploit military engineering at the operational level, the joint or combined force commander must recognize it as an essential aspect of his scheme of maneuver in an overall campaign plan involving naval, air, and land forces...”

is centered on expeditionary or combat-related activities, primarily of a service concern. Between these two is the operational level (i.e., subunified commands and joint or combined task forces), where campaigns are planned and fought. At this level, there must be balanced emphasis on both deliberate and combat engineer activities.

To fully exploit military engineering at the operational level, the joint or combined force commander must recognize it as an essential aspect of his scheme of maneuver in an overall campaign plan involving naval, air, and land forces, as appropriate. The object of operational maneuver is to orchestrate movements and engagements to seize, exploit, retain, or deny freedom of action to support the achievement of a common set of objectives. Freedom of action allows the efficient concentration of military capability when, where, and how it is needed; it applies to operations in both peacetime and war. At the operational level, freedom of

action can be achieved only through careful planning and seamless execution of deliberate and combat engineer functions in a well-synchronized and, where necessary, integrated effort.

Sufficient engineer resources to satisfy all requirements probably will not be available in all contingencies. Also, the nature of engineer priorities changes as a contingency evolves from reception, staging, and onward movement to force protection, operational maneuver, and ultimately, termination of operations and withdrawal. Resource limitations and the associated challenge of matching requirements with the right capability at the right place and time make it essential that the full range and versatility of all engineer assets be exploited.

Maximizing the use of resources to meet the needs encountered at each stage of an operation will often depend on the flexible use and, when necessary, task organization of troop construction, civilian contractor, and host-nation capabilities as integrated elements of a total contingency engineering effort. Given the unique requirements of a particular contingency, it will also require a well-trained joint engineer staff that is appropriately positioned to most effectively influence the full range of engineer functions.

Deficiencies in Current Joint Doctrine

Despite its importance to the overall success of joint operations and general acceptance of contingency engineering as the overarching concept for coordination of the joint engineer effort by the regional CINCs, there is no clearly defined program of engineer doctrine in the joint publication hierarchy.

What doctrine exists is incomplete and, at times, contradictory.

Joint Publication 4-04, *Joint Doctrine for Civil Engineering Support*, is assumed to be the "capstone" manual and, thus, the primary source of guiding doctrine on joint engineer matters for combatant commanders and their staffs. Though perhaps sufficient as general guidance for engineer management at the CINC level, it falls short of being adequate overarching doctrine across the full spectrum of joint operations. In particular, it fails to present principles underpinning the nature of engineer support for operational maneuver at the joint or combined task-force level and does not address gaps and inconsistencies elsewhere in joint doctrine. Finally, it does not reflect lessons learned from recent operations to the extent that they relate to engineer force organization, staff placement, and operations planning.

Consequently, each regional CINC is pursuing his own approach to contingency engineering, and implementation varies widely. Several major service commands, both active and reserve, have incorporated unique versions of the concept into their SOPs, training, and support relationships. Most recently, both the Army and the Navy have initiated comprehensive efforts to revise their service doctrine to reflect their views of contingency engineering considerations. USACOM, in its expanded role as joint force trainer, has independently established a training program for contingency engineering staff. These efforts are positive in that they serve to develop and promote application of the contingency engineering concept, but they are not coordinated with one another and lack a common base in joint doctrine.

The inadequacy of Joint Publication 4-04 as overarching doctrine becomes clearer when viewed in light of the key elements of military engineering it does not fully cover but that are considered significant enough to be addressed in other joint publications, typically in the operations or "3" series. They include, but are not limited to, Joint Publication 3-10, *JTTP for Rear Area Operations*, and Joint Publication 3-10.1, *JTTP for Base Defense*, which address aspects of survivability and sustainment support engineering. Also significant is Joint Publication 3-15, *Barriers, Obstacles, and Mine Warfare*, which deals with achieving operational advantage through mobility and countermobility engineering.

There are also significant gaps in joint guidance concerning areas such as topographic engineering, engineer intelligence, common design standards, real-estate acquisition, environmental mitigation, disaster recovery, wide-area decontamination, and engineer support for deep operations and targeting (i.e., employment of FASCAM and future intelligent wide-area munitions).

Logistics Paradigm and the Engineer Staff

Perhaps the most significant impediment to full and effective use of engineer resources in any contingency arises from the traditional view that, aside from the most basic combat-related tasks, engineering is predominantly a logistics function that is primarily concerned with the construction of facilities in support of the sustainment effort. The only joint guidance available, Joint Publication 4-04, reflects this view and is replete

with references to "civil engineering" and "facilities," but noticeably silent with regard to the engineer functions of mobility, countermobility, survivability, and topographic engineering as these relate to support of combat operations. This logistics paradigm is reflected in the staff organizations of major combatant and service commands, where engineering typically is a J4 function.

Four of the five regional CINCs have placed engineering under the J4 and have developed internal policies for contingency engineering based on this approach. The J4 model may be workable at the strategic or CINC levels, particularly in peacetime when the focus is on deliberate planning and facilities development. However, recent experience indicates this approach does not always work during contingencies. This is particularly true at the joint task-force level. Given the nature of current guidance, joint force commanders have a tendency to view the engineer function in its strategic (sustainment engineering) or tactical (combat engineering) extremes. They often fail to recognize or fully capitalize on the advantages of a total engineer effort that is integrated as an essential part of their operational scheme of maneuver. Thus, joint task-force staffs are often organized accordingly.

At the joint task-force level, when subordinate to the J4, the staff engineer is not well positioned to coordinate or monitor the total contingency engineering effort in support of operational maneuver. The engineer's visibility in operational planning and decision making is significantly curtailed; interaction with and advice to other staff functions is unnecessarily limited; and independence and the ability to exercise

initiative are diminished. The result tends to be engineer support for the joint force shaped solely through the eyes of the logistician, whose primary focus is on just one key aspect of the joint campaign: force sustainment. Placement within the J4 staff increases the likelihood that the full value of engineering will not be realized and that key engineer-related issues may not surface to the joint or combined force commander in time for resolution.

Neither Joint Publication 0-2, *Unified Action Armed Forces*, nor Publication 5-00.2, *Joint Task Force Planning and Procedures*, specifies staff placement of the engineer in the joint force structure. While Joint Publication 0-2 assigns supervision of engineer functions to the J4, Joint Publication 5-00.2 is contradictory on joint staff responsibility for engineering. It states that J3 responsibilities include mine warfare; reconnaissance; rear-area protection and security; disaster relief; and mobility, countermobility, and survivability operations, all of which are heavily engineer-related. However, it also states that J4 responsibilities include engineer reconnaissance and intelligence, bridge and river crossings, barrier operations, general construction, and base development and maintenance. Aside from base development and maintenance, each of the other responsibilities assigned to the J4 is more operational than logistics in nature and overlaps considerably with those of the J3.

Although neither Joint Publication 0-2 nor Joint Publication 5-00.2 specifies placement of engineers, both publications reinforce the joint force commander's prerogative to organize the staffs as necessary to accomplish the mission. In the few recent instances where the joint force staff

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engineers were placed outside the logistics organization (i.e., as special staff), the wisdom of affording the engineer greater independence was ultimately validated.

Joint Training

Fundamental to the nature of joint operations is the need to tailor force packages and command structures to suit the situation at hand. Although the joint force engineer staff initially may be built around the headquarters element of the dominant component command, this staff typically is augmented with individuals drawn from other components and agencies. Since the makeup and level of competence of the engineer staff is critical to the ultimate effectiveness of the total engineer effort, it is important that these individuals have a common basis for interacting as a team. Gaps and inconsistencies in current joint doctrine and the lack of joint engineer staff training programs make this requirement difficult to achieve.

To a greater or lesser degree, regional CINCs and major component commands have established directives

and SOPs to provide local guidance on contingency engineering operations, but approaches vary widely. It is apparent that these differences are not only due to the unique characteristics of a given area of responsibility (AOR) but how, in the absence of adequate guiding doctrine, alternative views on the concept of contingency engineering have evolved over time. The lack of some appropriate level of uniformity in the application of these principles serves to confuse staff augmentees and may result in conflict between the way a major component command and a regional CINC plan to conduct their operations.

The lack of relevant doctrine and the limited number of personnel experienced in joint contingency engineering operations, combined with the usual staff turbulence, causes a situation where the same lessons are relearned over and over. Opportunities to train service personnel in contingency engineering concepts are few. Engineers typically are not permitted a strong presence in joint exercises, and engineer issues are most often assumed away by operational commanders. Although some major reserve organizations have the mission and capability to train and provide engineer staff augmentation (i.e., the Army Reserve's engineer commands and the Reserve Naval Construction Force Support Command), these organizations will not be the first to provide personnel to go “down range.” A larger pool of active duty engineers from each service must be trained in contingency engineering techniques. However, this assumes a common base in joint doctrine and interservice compromise on engineer staff practices.

In its role as joint trainer for assigned CONUS-based forces and joint task force staffs, USACOM has

developed and implemented a program of instruction (POI) for *Engineer Support to Joint Task Forces*. In addition, the Army's Battle Command Training Program (BCTP) concept is being adapted to exercise joint task force commanders and staffs. This "JBCTP" focuses on joint staff practices, planning, and doctrine as well as tactics, techniques, and procedures. The USACOM POI and the engineer component of the JBCTP are important steps forward in providing platforms for joint contingency engineer training. However, these initiatives have been largely shaped from the perspective of the organizations that developed them. They do not reflect input from other combatant CINCs or the major service commands with direct experience in contingency engineering operations. Developed in the absence of clear joint guidance as their foundation, these initiatives run the risk of becoming joint doctrine by default.

Conclusion

In an era of reduced force size and limitations on strategic lift, it cannot be assumed that a joint or combined force will have enough engineer resources when and where they are required in a contingency. Therefore, it will be essential to get the most out of the resources available. The future development of joint engineer doctrine should do everything possible to support this need.

Existing joint doctrine is incomplete and fragmented. This, along with the view that engineering is primarily a logistics function with an emphasis on force sustainment, has hampered the efficiency of the total engineer effort in support of operational maneuver. These factors

pose important implications for the successful planning and execution of future joint and combined operations. Steps must be taken now to systematically improve joint doctrine, engineer planning systems, and staff training programs to flexibly meet the needs of current and future contingencies.

Recommendations

1. Publish more effective guidance for joint engineer operations; fully develop the concept of contingency engineering to reflect its evolving practice in the field.

a) Revise Joint Publication 4-04, *Joint Doctrine for Civil Engineering Support*, as an interim measure and develop a new publication to serve as overarching engineer doctrine.

b) Ensure coverage of the full span of engineer functions—mobility, countermobility, survivability, topography, and sustainment—in support of operations.

c) Define the broad role of the engineer in deliberate and crisis action planning and execution, to include support for the intelligence, operations, and logistics efforts.

2. Propose principles and options to guide joint commanders in staff organization and placement, and emphasize early involvement, freedom of action, and ongoing visibility.

a) Propose revisions to other publications to ensure that references to engineering throughout the doctrine hierarchy are consistent with the concepts outlined in new, overarching doctrine.

b) Revise Joint Publication 0-2, *Unified Action Armed Forces*, to elaborate on the importance of exercising flexibility in the position of the staff engineer in accordance with the needs of a given contingency.

c) Revise both Joint Publications 0-2 and 5-00.2, *Joint Task Force Planning and Procedures*, to resolve the ambiguity and/or potential conflict in responsibility concerning engineer matters between the joint task force J3 and the J4.

d) Revise Joint Publication 5-00.2 to outline the principles and options governing engineer staff placement and functions.

3. Develop joint tactics, techniques, and procedures (JTTP) to amplify concepts presented in a revised and/or new publication and to fill specific gaps identified in engineer doctrine.

a) Revise existing JTTPs and those in development to reflect the concept of contingency engineering and related principles, as presented in new overarching doctrine.

b) Evaluate the need and propose new JTTPs covering such topics as, but not limited to, topography, environmental mitigation, civilian contracting, real estate, wide-area decontamination, disaster recovery, and design standards.

4. Pursue a comprehensive strategy to increase knowledge of and competence in joint contingency engineering operations among combatant commanders and engineer staffs.

a) Establish a formal training program for joint force engineer staffs, building on work already completed by USACOM and the Army's Battle Command Training Program.

b) Promote a stronger role for engineers in Joint Chiefs of Staff-sponsored exercises and consider formulation of an ongoing engineer exercise program to run in parallel.

c) Introduce contingency engineering concepts and familiarization with emerging doctrine in the syllabus of service and joint command schools.

"Engineers Lead The Way!"



ICE BRIDGING IN ALASKA

By Captain Joseph E. Staton and Staff Sergeant Clinton K. Brown II

Soldiers participating in arctic operations must deal with extremely cold temperatures, long periods of darkness, and snow-covered terrain. In these conditions, simple tasks take much longer to accomplish, and new or complex tasks are difficult to complete. Units must be prepared to live, eat, and rest in the open at temperatures far below zero. The environment is unforgiving and mistakes can be costly.

This article provides information from several references and personal observations on reconnaissance of ice bridge sites and construction of ice bridges, which are one means of increasing mobility in severe weather conditions. Under arctic conditions, mobility requires unique considerations.

Cold temperatures and rapidly freezing water are beneficial in ice bridge construction, but they also create problems. Extreme cold takes a toll on soldiers as well as equipment. Since personnel involved in this type of construction are vulnerable to frostbite and hypothermia, tents are a necessity so that soldiers, hoses, and equipment have a place to thaw out.

Ice Crossings

Ice bridges are a viable means of crossing rivers in an arctic environment, because they are inexpensive and field expedient. They free up tactical bridging assets for maneuver operations, do not need to be taken up, and potentially can carry heavy loads. Disadvantages are that they are dependent on weather, are manpower intensive (they must be monitored constantly), take 2 to 8 weeks to build, and are usable only a few months of a year.

In Alaska, the 47th and 23rd Engineer Companies conduct annual training on ice crossings. Near Fort Wainwright, the 47th constructs and maintains several ice bridges that provide land access to large arctic training areas.

Arctic Strike '96

Recently, the 47th participated in Exercise Arctic Strike '96 at Fort Greely. The unit's primary mission was mobility and evaluation of possible crossing and helicopter landing sites. The exercise was a valuable training opportunity to work directly with and provide support to maneuver and aviation elements.

Conditions for building an ice bridge were favorable. Temperatures had been well below zero for more than 60 days, and the frozen rivers provided numerous crossing sites.

Most of the exercise was conducted at temperatures ranging from -30 to -57 degrees Fahrenheit. When it warmed up to -20 degrees, the wind increased and the wind chill was at or below -65 degrees. With this chill factor, preservation of personnel—or asset conservation—was more important than the mission.

Reconnaissance

The success of a river-crossing operation depends on the reconnaissance crew's assessment of possible crossing sites. The ice-reconnaissance crew is a squad-sized element consisting of a squad leader, an ice measurer, a recorder, four auger operators, and two soldiers to measure for the next hole.

The crew uses an akio sled to transport the following equipment:

- ☐ Power augers (2)
- ☐ Hand augers (2)
- ☐ Dippers (2)
- ☐ Measuring rod (1)
- ☐ Measuring tape, 100-foot (1)
- ☐ Ice axes (2)
- ☐ Fuel can, 5-gallon (1)
- ☐ Safety rope, 100-foot (1)

Before the reconnaissance begins, the crew establishes security and erects a warming tent. Then it evaluates existing ice conditions to determine the best bridging method to use and the amount of time required to establish a crossing site. Ice uniformity varies along the length of a river or lake, and its thickness depends on snow depth, water current, and springs.

An ideal crossing site meets the following requirements:

- ☐ The river channel is straight at the crossing.
- ☐ The river occupies one main channel and is wide enough to allow a slow current.
- ☐ The bank approaches are gradual (less than three percent).
- ☐ The site is not immediately downstream from creeks or streams or near open bodies of water.
- ☐ The site is near an existing road network.
- ☐ The ice is level.
- ☐ The ice is free of warm springs, sand bars, and deep snow drifts.

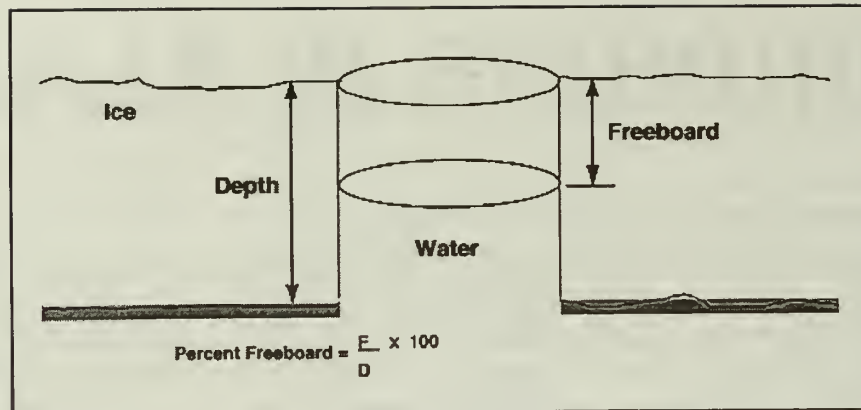


Figure 1 - Freeboard

To perform initial reconnaissance, the crew bores holes in the ice, measures its thickness and freeboard (the amount of ice exposed in the hole above the waterline (Figure 1), and completes an ice bridge profile.

The first hole is bored 20 feet downstream of the proposed centerline and 5 feet from the bank. Test hole distances and layout are shown in Figure 2. During the initial reconnaissance, the crew bores holes completely through the ice to ascertain how it is supported. They determine the bottom conditions and water depth under the ice, plot the borehole depths and the depth to the bottom, and estimate conditions between the holes by connecting the dots with a curve. Their ice bridge reconnaissance report includes:

- ☐ Date of the reconnaissance
- ☐ Individual and unit doing the profile
- ☐ Name of the bridge

- ☐ Horizontal and vertical scales
- ☐ Channel number of the bridge
- ☐ Classification data for that channel and whether the channel is critical or not (refer to the channel with the lowest military load class [MLC])
- ☐ Type of ice on the channel
- ☐ Graph showing ice and water depth and air voids

After the bridge profile is complete, the crew classifies the bridge using the following formulas:

$$W = \text{MLC (wheeled)} = \frac{(T^2)CS}{25}$$

and

$$A = \text{MLC (tracked)} = \frac{(T^2)CS}{20}$$

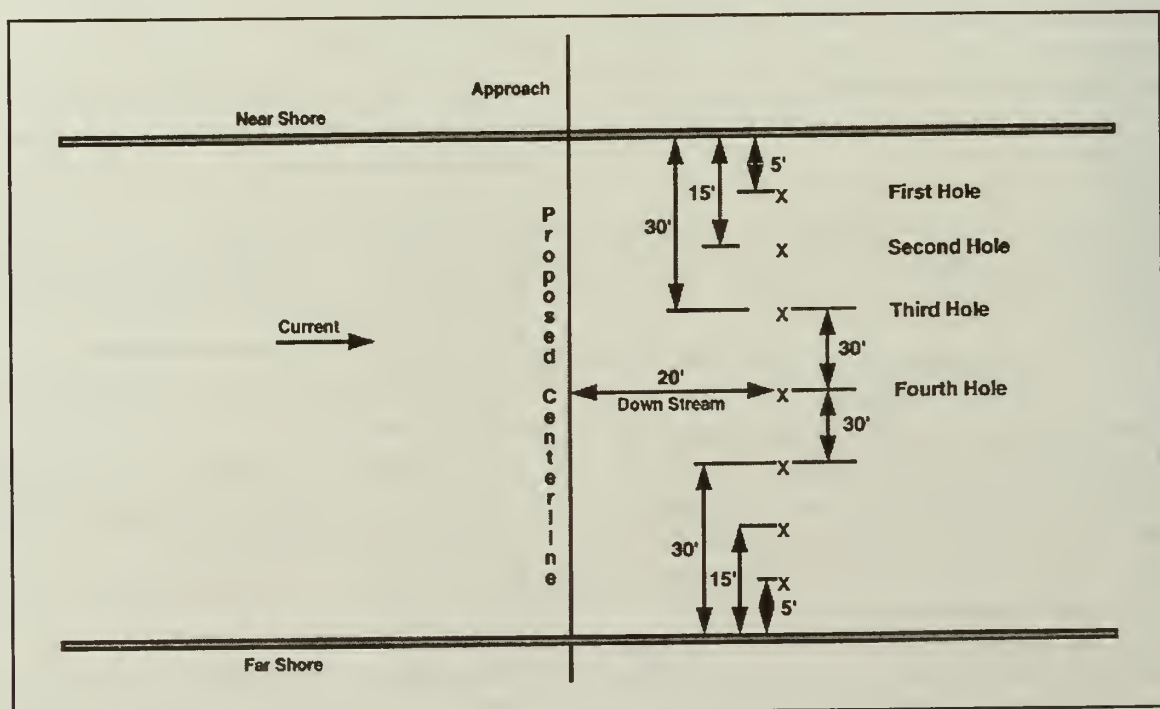


Figure 2 - Test Hole Layout

Note: To provide a safety factor, round down to the next whole number.

Where: T = ice thickness, in inches

C = color factor (Table 1)

S = strength factor (Table 2)

Table 1. Determining Color Factor of Ice

Ice Color	Factor (C)
Clear (transparent or black)	1.0
Semiclear (both transparent and black and white layers)	0.9
White (snow mixed with ice)	0.8
Discolored (stained yellow or brown)	0.7

Table 2. Determining Strength Factor of Ice

Ice Condition	Ambient Temperature	Factor (S)
Solid	Remained at or below freezing for the previous week	1.0
Solid	Above freezing during the day, below freezing at night	0.9
Solid	Water is running on the surface from runoff or overflow	0.8
Not solid	Water or air pockets are found between layers	0.7
Has air under it	Ice is not supported by water (freeboard is <90 percent)	0.6

The reconnaissance crew determines the classification of each channel in the river based on the thinnest ice thickness found. The critical channel is the one that limits the entire class of the bridge and/or has the lowest MLC. If the ice is frozen to the bottom of the channel, it is classified as unlimited. The classification is also unlimited if 2 inches or less of water is under the ice, because the load on the bridge would flex the ice to the bottom of the channel.

A quick reference card (issued by the U.S. Army Cold Regions Research Engineering Laboratory [USACRREL]) provides information to quickly evaluate possible crossing sites (Figure 3, page 36 and Table 3, page 37). Note the distances between vehicles when using this card. The color and strength factors can be used with the card to further define the ice.

Landing Zones

When evaluating possible helicopter landing zones (LZs), consider the following:

- ❑ Helicopter spacing on ice is the same as that for vehicles (150 feet); however, helicopters must land harder on ice than usual (1.2 to 1.3 times the force of gravity) so the wheels will set down more firmly on the surface and avoid sliding.
- ❑ When evaluating lakes as LZs, bore the first four holes as if it were an ice bridge (Figure 2, page 34), then space the holes 100 feet apart.
- ❑ The MLC of static loads on the ice must be doubled (for example, a fully loaded CH-47 weighs 49,000 pounds, giving MLC 42 for ice LZs).
- ❑ When parking on ice, bore a hole 20 feet from the vehicle. If water flows out of the hole onto the ice, move to another location immediately.

Strengthening Natural Ice

If the strength of existing ice meets traffic requirements, the only necessary steps for building an ice bridge are to compact the snow layer to 2 inches, improve the approaches, and mark the centerline. If conditions do not meet the required specifications, two options are available: use standard Army bridge construction or strengthen the ice.

Ice forms naturally from the bottom of an ice sheet when the temperature is cold enough. Ice and snow are insulators and control the natural formation of ice—the thicker the layer of insulation, the slower the ice growth. The ice formation process can be speeded up by flooding the surface of existing ice where it is exposed to the air and not insulated. An ice bridge should be at least 150 feet wide to allow for ice strengthening along the entire section of the ice sheet carrying vehicular loads.

A flooding crew consists of a supervisor, a warming tent guard, an equipment operator, one to three pump operators, and a hose handler.

The type of pump used to flood the ice depends on the temperature and the pumps available. Submersible, electric pumps are best. They do not freeze up as easily since the water and ice are in equilibrium at or near 32 degrees. The 47th and 23rd Engineer Companies use surface-operated pumps (typhoon pumps manufactured by Wayjax, NSN 4320-00-Z27-5852). These pumps have gas engines that tend to freeze up every 20 to 30 minutes, requiring that they be rotated through the warming tent. Other pumps, such as chain-belt and Gorman-Rupp pumps (both with free-standing, gas-operated engines) may be used as long as the hoses can withstand sub-zero temperatures. The pneumatic tool and compressor outfit (250 cubic feet per minute [CFM] trailer) comes with sump pumps that continue to run below

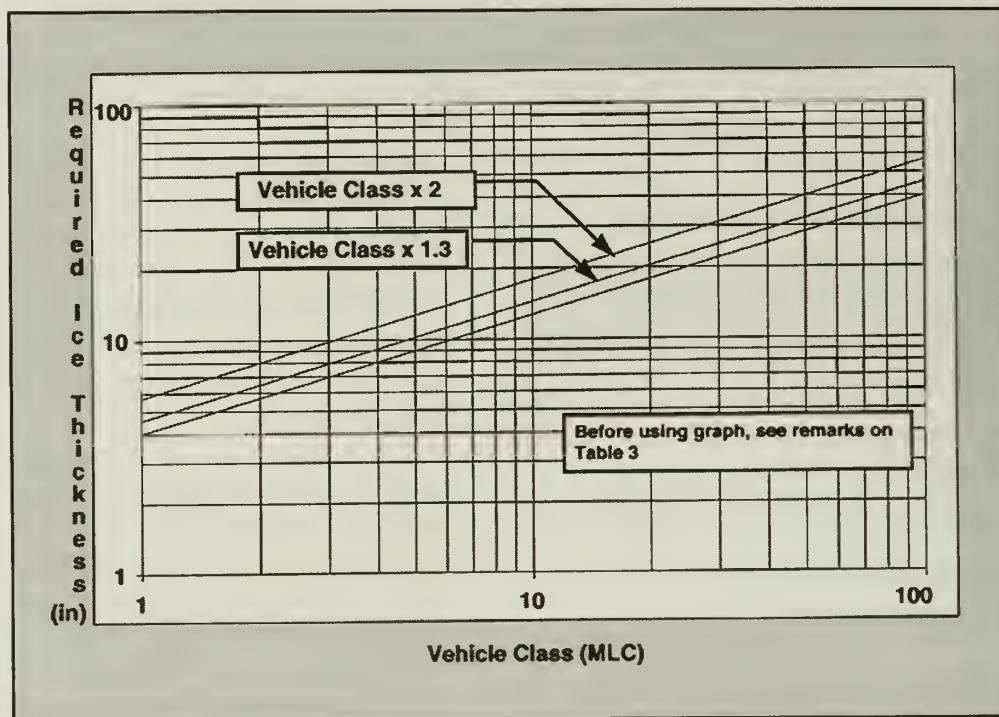


Figure 3 - Quick Reference Graph

the surface. The compressor hoses on the surface are exposed to sub-zero temperatures (down to -60 degrees). A concern is that the 1 1/2-inch hose, which operates at 100 to 200 CFM, may break and injure a soldier. However, arctic hoses that stay flexible to -60 degrees may be purchased locally.

If the snow layer is deep, pumping water on it may cause voids in the ice. Much of the snow must be removed by a crew consisting of a supervisor and equipment operators as necessary (for the SEE tractor, grader, bucket loader, snow blower, or shovel).

The snow removal crew must avoid pushing the snow into berms along the sides of the bridge area for two reasons. First, moving heavy snow from one area and concentrating it on the sides causes the ice to form into a crown in the center of the roadway. Then water applied to the center of the bridge will drain to the sides, failing to strengthen the roadway of the bridge. The crown also may develop an air pocket and become unsupported (freeboard less than 90 percent, which will not permit safe passage of vehicles). Second, ice will not form on the bottom of the ice sheet near the snow berm. This leads to thin ice along the edges, which can cause the bridge to fail (Figure 4 and Figure 5, page 38).

The crew removes the snow on the surface until the layer can be compacted to 2 inches or less. Then they flood for the first lift (layer). The flooding depth depends on the available equipment and the air temperature. Normally, one 2-inch lift can be completed in each 24-hour period. Under extremely cold temperatures, more than one layer may be applied per

day. Once the first lift is completely frozen, successive lifts can be placed until the bridge reaches the desired classification. To avoid water pockets between the layers, each lift must be completely frozen before the next lift is added. The time required for the water to freeze depends on the air temperature, wind speed, and floodwater depth. As the ice thickens, the bridge takes on a dish shape because the heavy section of ice causes the water to pool naturally (Figure 6, page 38).

Bridge Maintenance

Ice bridges require daily maintenance, because river ice thickness can change daily. The thickness also varies throughout the winter and in different locations on the river. Thickness of river ice depends on the current strength and temperature variations (air and water). The critical ice channel depth must be checked and the bridge capacity reclassified daily. Constant travel over the same path may cause the ice to become thin in that area.

If temperatures rise above freezing, all channels of the bridge must be checked. During the daily check, look for changes in the color of the ice and strength factor requirements. Compact new snow to 2 inches or less and flood or remove the excess. If temperatures remain below freezing, check all of the channels every 3 days. If any of the channels must be strengthened, traffic cannot cross until the lift has frozen completely. When the ice bridge is thick enough to support the heaviest crossing vehicle, spread and pack 1 to 2 inches of snow over the roadway to provide traction and a wearing surface.

Table 3. Field Guide Quick Reference Card

Vehicle Class (wheeled or tracked)	Required Ice Thickness (inches = $4\sqrt{\text{veh class}}$)		Distance Between Vehicles (about 100 x thickness [in cm])	
	(in)	(cm)	(ft)	(m)
200 lbs	2	5	17	5
1	4	11	34	11
2	6	15	48	15
3	7	18	58	18
4	8	21	67	21
5	9	23	75	23
10	13	33	106	33
15	16	40	130	40
20	18	46	149	46
25	20	51	167	51
30	22	56	183	56
35	24	61	198	61
40	26	65	211	65
50	29	72	236	72
60	31	79	260	79
70	34	85	280	85
80	36	91	300	91
Before using table, see remarks below:				
1. If the air temperature has been above freezing for more than 6 of the past 24 hours, multiply the vehicle class by 1.3 to obtain the required ice thickness. If the air temperature stays above freezing for 2 hours or more, the ice starts to lose strength, and the table no longer represents safe conditions. A rapid and unusually large temperature drop causes the ice to become brittle, and travel may not be safe for a period of 24 hours. 2. For the distance required between two vehicles of different classes, use the distance required for the higher class. 3. If you plan to park for extended periods, multiply the vehicle class by 2 to obtain the required ice thickness and maintain at least the original distance requirements. Drill a hole through the ice near the vehicle and move if the ice begins to flood. 4. The ice must have water support. Be very careful close to shore. Very often the water level will drop after freeze-up. When this happens, the ice close to the shore may no longer have water support. 5. Cracks are either dry or wet. If dry, they do not penetrate ice cover and can be ignored. If wet, multiply the vehicle class by 2 to obtain the required ice thickness and try to drive straight across the cracks (avoid going parallel to wet cracks).				

During construction, cracks will appear everywhere in the ice bridge and loud snaps may be heard. The noises are caused by the thermal expansion and contraction of the entire ice mass and do not indicate failure of the bridge itself. Many cracks are caused by sudden changes in temperature. These are usually dry and do not weaken the bridge. They can be flooded and refrozen if desired. If a vehicle crosses that is classified at or above the bridge load class, wet cracks may form. They will refreeze, strengthening the bridge. If the temperature is below freezing, harmless cracks perpendicular to the flow of traffic will be visible.

If the bridge banks have a slope greater than 3 percent, use snow to reduce the slope. Pump water on a snow pile to make wet, heavy snow, which is good for construction. The snow pack will freeze and the 1- to 2-inch snow cover acts as a wearing surface.

Air voids normally occur near river shores because the water recedes after the initial freeze. Ice that is not supported by water is very weak. Breaking the ice sheet and setting it back on the water will greatly increase the strength of the ice. Use a wrecking ball and crane to break the ice, or load it with enough wet snow to cause it to break. Boring holes in the ice will also help. If the ice sheet does not break up, try another location. Push dirt or snow over the ice to the supported area of the bridge, especially near the banks, or use planks to move the load to the supported ice.

Crossing an Ice Bridge

Mark ice bridges like any other river crossing as shown in FM 90-13. Place signs near the bridge to inform drivers of safety precautions. Place a marker 150 feet from each shore to determine the proper vehicle spacing on the bridge.

Before vehicles are allowed to cross, drivers must be aware of the following safety precautions:

- ☐ Bridge classification is for one-way traffic only.
- ☐ Avoid crossing if the vehicle classification exceeds the limits of the bridge.
- ☐ Passengers need not dismount or open doors during a crossing.
- ☐ Stop vehicles before driving onto the ice bridge to reduce the impact.
- ☐ Space vehicles at least 150 feet apart.
- ☐ Maximum speed on the bridge is 10 mph. Keep vehicles in the lowest gear possible. Driving too fast may create a wave ahead of the vehicle and cause the bridge to fail.
- ☐ Avoid stopping on the bridge. A sudden application of brakes increases the weight pressure of a vehicle, especially in the front wheels.

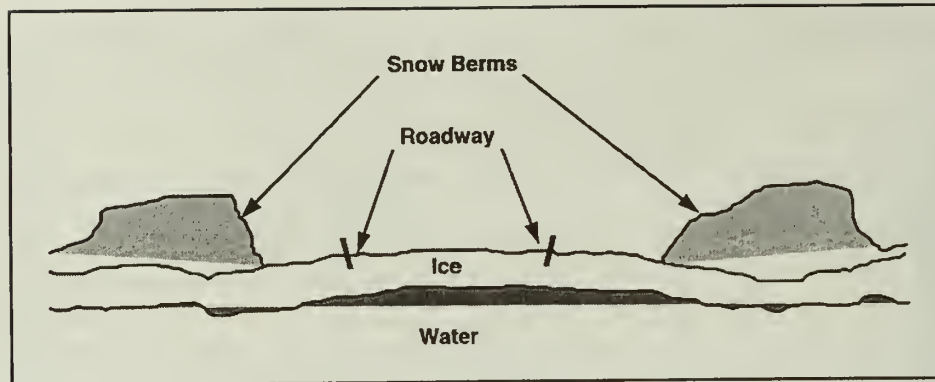


Figure 4 - Cross Section of Bridge and Berms

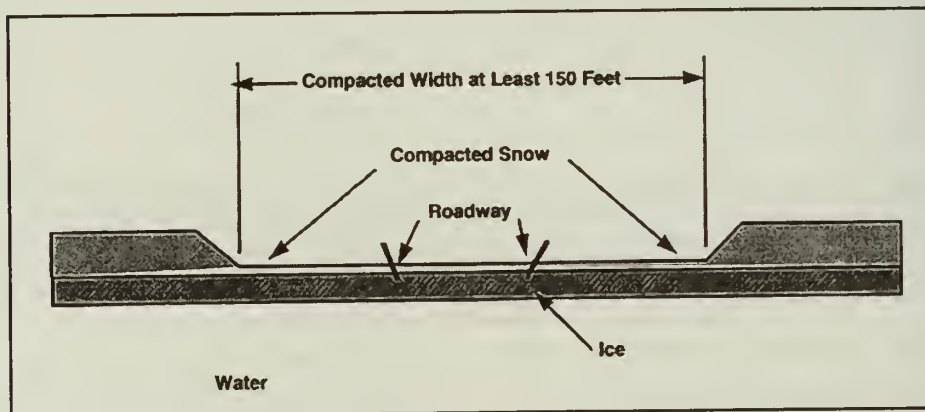


Figure 5 - Cross Section of Snow Compaction

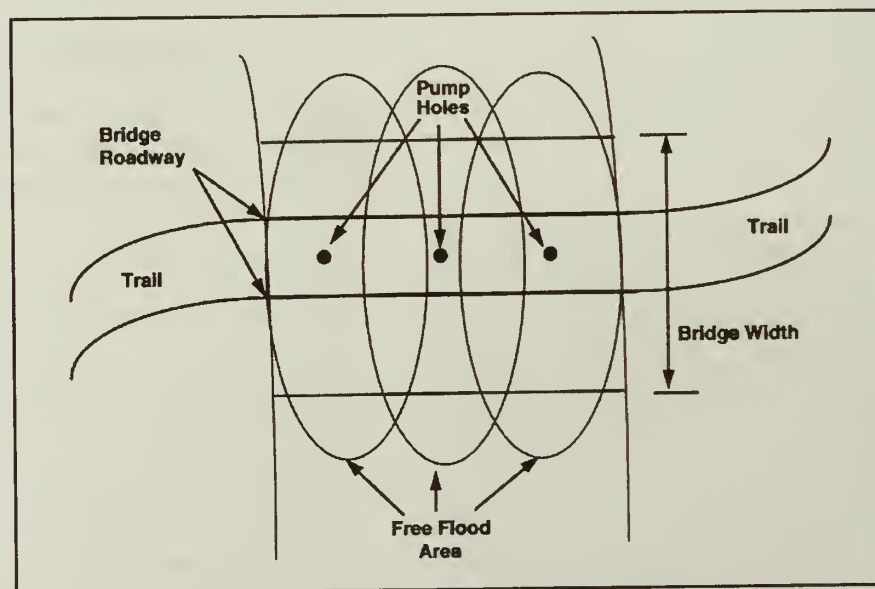


Figure 6 - Location of Pump Holes for Flooding the Bridge

- ❑ If parking on the ice is unavoidable, double the vehicle classification and bore a hole 20 feet from the vehicle. If water surges out of the hole and floods the ice, move the vehicle immediately.

Prepare a recovery plan for vehicles that break down on the ice bridge. During recovery, vehicles should not exceed the 150-foot spacing requirement unless the combined load is less

than the bridge classification. If the combined load exceeds the classification, choose another recovery method. If the ice fails, a team must be prepared to react quickly. A slow response could allow ice to form around the vehicle, requiring demolitions to free it. The first vehicle at or near the maximum bridge classification should have a tow cable connected to the pintle and thrown on top of the vehicle to aid in recovery.

Conclusion

Engineers must be prepared to deploy anywhere in the world and to provide expertise in many areas. In cold environments, the battlefield may require that they build ice bridges to gain access to critical regions. Ice can enhance maneuverability for both vehicular and air mobile traffic. A thorough knowledge of ice bridging allows engineers to overcome one of the major problems faced in cold-weather operations.



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1. 6th Infantry Division (L) Pamphlet 350-11, *Squad Leader's Guide for Constructing Ice Bridges*, October 1986.
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Captain Staton is the engineer advisor, U.S. Army Readiness Group, Fort Sill, Oklahoma. Previous assignments include commander, 47th Engineer Company (C)(H), Special Troops Battalion, Fort Wainwright, Alaska; A/S3 Construction, 555th Combat Engineer Group and XO, HSC, 864th Engineer Battalion (C)(H), Fort Lewis, Washington. Captain Staton has had two National Training Center rotations. He is a graduate of the Engineer Officer Advanced Course

Staff Sergeant Brown is the Engineer Operations NCO for the Special Troops Battalion, Fort Richardson, Alaska. Previous assignments include station commander, Derby, Kansas, Recruiting Station; squad leader, 23rd Engineer Company, Fort Riley, Kansas; and he served with P Company, 293rd Engineer Battalion, 18th Engineer Brigade, Baumholder, Germany. Staff Sergeant Brown is a Basic NCO Course graduate.



Engineer Problem

Using the information provided in the above article, test your knowledge by completing the following exercise.

Situation: Your company is deployed to a remote cold-weather region. The task force commander directs a reconnaissance of a possible ice bridge crossing site. The platoon you task to perform the reconnaissance provides the following report:

- ☐ Critical ice thickness = 43 inches
- ☐ Water depth below the ice = 60 inches
- ☐ Type of ice = Semiclear with dry cracks
- ☐ Temperatures have been below freezing for at least a week
- ☐ Freeboard = 25 percent
- ☐ Width of river = 600 feet
- ☐ Critical channel width = 335 feet

Use the equations on page 37 to determine the following:

1. Determine the military load classifications (MLCs) of the bridge for wheeled and tracked vehicles.
2. Determine how long it takes to increase the strength of the bridge to safely cross an M1A1 tank if temperatures remain below zero.

Engineer Solution is on page 47.

MANSCEN Construction

By Major Steven M. Herold and Major Neil F. Wilson

Realignment of the Chemical and Military Police Schools from Fort McClellan to Fort Leonard Wood grows ever closer to reality. The realization of the impending moves is brought to life in artistic renderings and models depicting \$203.4 million (M) in construction projects for the Maneuver Support Center (MANSCEN). These construction efforts will propel the MANSCEN into the Army's showcase of consolidation, while retaining individual regimental identity and proponentcy. Construction will begin after the ongoing Environmental Impact Statement (EIS) is completed and approved. The EIS process is on schedule, which should allow the two-year construction effort to begin in the spring of 1997.

The MANSCEN is one of the future TRADOC clusters that will be organized around battlefield functions. The TRADOC concept will link like battlefield functions into mutually supporting school clusters to enhance execution of training, doctrine, and combat developments.

The table on this page shows the expected impacts of the two additional schools on the population at Fort Leonard Wood.

General Instruction Facility

The General Instruction Facility (GIF), a \$58M project, will connect to the current Engineer

Center headquarters to form the MANSCEN headquarters and schools complex. The building plans should be 95-percent complete by December 1996. The MANSCEN staff and the Engineer, Chemical, and Military Police School staffs will take up residence in the new complex in the second half of FY99. While some of the building space is dedicated to unique branch control, much of it will be used by all the schools.

Many training functions will take place in the new building. It will include general instruction classrooms, numerous applied instructional facilities, and administrative areas that support the Chemical and Military Police Schools and the combined Noncommissioned Officer (NCO) Academy. Many classrooms are designed for small-group instruction and some have moveable walls to allow use by larger groups. Classrooms will

have fully hard-wired multimedia and computer-linked training capabilities to support the high-tech Classroom XXI concept.

A computer-based simulations "Warfighter Training Center" will be located within the GIF, where Engineer, Chemical, and Military Police officers and NCOs will train on both combined and branch battlefield functions. Engineer officers and NCOs will train on mobility, countermobility, and survivability operations; and general and topographic engineering skills. Chemical officers and NCOs will use the intelligence-preparation-of-the-battlefield and the deliberate decision-making processes to advise battalion and brigade commanders on nuclear, biological, and chemical (NBC) contamination avoidance, protection, decontamination, smoke, and flame operations. Military Police officers and NCOs will train the Military Police

Projected MANSCEN population

Category	BRAC Impact	FY99 Post-BRAC Population
Military permanent party	1,599	6,231
Trainees/students (average daily load)	3,378	11,684
Civilian workers	498	4,892
Family members	3,621	12,005
Total	9,096	34,812



Artist's conception of the Military Police Village

battlefield missions of circulation control, area security, enemy prisoner of war, and law enforcement operations. The top-notch simulation capabilities will replicate contingency operations and provide Military Police leaders experience in planning and executing missions to support maneuver forces.

The General Instruction Facility will house some of the Chemical School's most critical training areas, such as the Radiological Laboratory (Rad Lab) and the NBC Reconnaissance and Biological Integrated Detection Systems (BIDS) training simulators. The Rad Lab will be used to instruct all Chemical Corps soldiers on the fundamentals of radiation protection, monitoring, and equipment operations. Instructors will also use the lab to train radiation safety officers assigned throughout the Army. The NBC Reconnaissance and BIDS training simulators will use state-of-the-art technology to provide advanced training to selected Chemical Corps soldiers.

Critical facilities inside the GIF for specialized Military Police training will provide physical security areas, including a mock arms room, interview and interrogations rooms, a computer fraud room, and mock crime scenes. Military Police officers and NCOs will use the high-tech classrooms for professional development courses.

Military Police Village

While the General Instruction Facility will provide the majority of resources to instruct officers and NCOs, the Military Police Village will be the primary location for Military Police one-station unit training (OSUT) and advanced law enforcement training (ALET). More than 15,000 military and civilian personnel will be trained in the Military Police Village each year.

The buildings in the Military Police Village that support the skill level 1 training tasks of OSUT soldiers will

also provide classroom and administrative space for students and instructors. A weapons simulator will allow students to improve gunnery skills. Mock facilities include a Military Police station, a confinement facility, a communications lab, and a minimall storefront. In its entirety, the village provides OSUT students a mock community with streets, parking lots, businesses, and homes, where Military Police soldiers will practice patrolling and crime-scene techniques.

The Tactical Clearing Complex (TCC), part of the Military Police Village, will provide mock military installation facilities. These facilities will include a credit union, medical clinic, and single-family and duplex living quarters where soldiers and civilians will practice ALET techniques. The ALET staff will train about 5,700 students, including 3,300 federal, state, and municipal law enforcement personnel, in this state-of-the-art training complex. Two of the ALET's primary TCC users will be

students in the Special Reaction Team (SRT) training course and the Counterdrug Special Weapons and Tactics Course. A large administrative building in the TCC will provide classroom and administrative areas.

Chemical Defense Training Facility

The "crown jewel" of the Chemical School facilities is the Chemical Defense Training Facility (CDTF). This \$28M project will be the location of toxic agent training. The commandant of the Chemical School views this facility as the place where all Chemical Corps soldiers prove that chemical defense doctrine, training, and materiel (detection kits, decontamination kits and solutions, and protective equipment) work effectively. Most importantly, soldiers

will become confident in their equipment, procedures, and themselves. This confidence will be transported to the soldiers' next units. Allied and international soldiers and personnel in various federal, state, and city agencies also will train at the CDTF.

Decontamination Apparatus Training Facility

The other major Chemical School facility in the construction project is the Decontamination Apparatus Training Facility (DATF), used to instruct light and heavy decontamination equipment techniques. The interior will house the "hands on" equipment training while the exterior will provide a thorough decontamination site. There soldiers will apply their training knowledge to

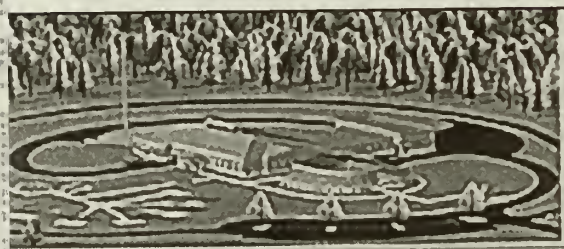
simulated contaminated equipment and personnel.

Ranges and Training Areas

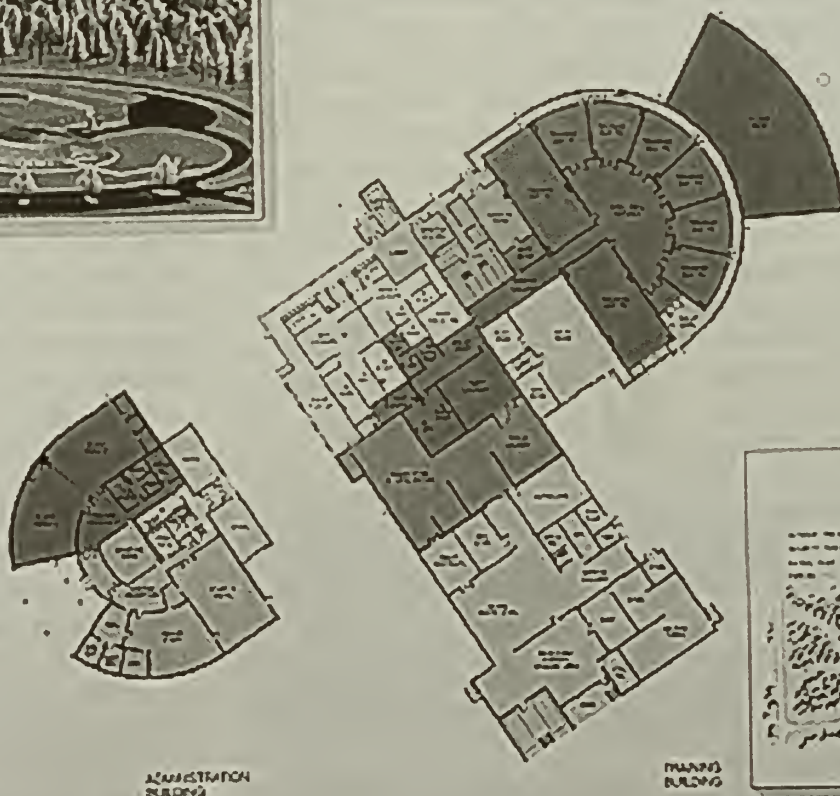
In addition to the facilities construction, the Chemical and Military Police Schools will receive new ranges and training areas to execute core training.

Chemical soldiers will train to standard on several new areas: Range 27/27A, the flame field expedience range; static and mobile smoke training areas; range instructional facilities; NBC Reconnaissance and BIDS field training exercise sites; and operational decontamination sites.

Range 19 on Fort Leonard Wood will be upgraded to an MK19 (40-millimeter grenade machine-gun) range for Military Police training. The Military Police will also receive Range 13, an SRT complex,



AERIAL VIEW

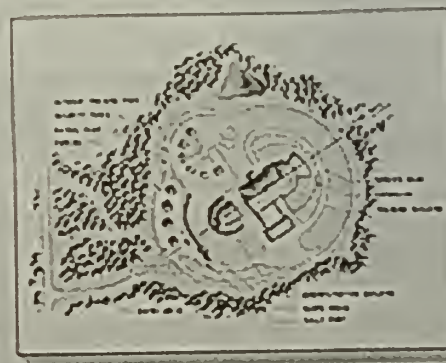


FLOOR PLAN



ADMINISTRATION BUILDING

TRAINING BUILDING



SITE PLAN



Site plan for Chemical Defense Training Facility



Artist's conception of new Unaccompanied Enlisted Personnel Housing Facility

where they will receive specialized training in weapons, to include mini-uzis, shotgun, pistol, and sniper rifles. Range 13 will allow live-fire building-clearing exercises that add a high degree of realism to SRT training.

Military Operations in Built-Up Areas Training Site

A military operations in built-up areas (MOBA) (formerly called military operations in urban terrain [MOUT]) training site will provide all Fort Leonard Wood soldiers the ability to train in a highly realistic urban environment. The MOBA village will consist of 16 buildings—9 intact and 7 partially rubble. Several have two stories, and one is a three-story apartment building. The village also will contain an underground sewer complex that has safe subterranean egress and ingress routes.

Unaccompanied Enlisted Personnel Housing

NCO students will reside in a newly constructed unaccompanied enlisted personnel

housing complex. The building will feature 888 beds, an operations center to provide soldier support services, a community building, and a dining facility. The building design, window styles, and landscaping provide a college-campus look to the dormitory setting. The facility is conveniently located adjacent to the General Instruction Facility, which houses the NCO Academy.

Artifact Storage Facility

A two-story, climate-controlled artifact storage facility will be added to the current Fort Leonard Wood museum. The Engineer, Chemical, and Military Police Schools will share equally in the new facility and the existing museum, where each regiment will display artifacts depicting unique branch history.

Conclusion

The quality of the planned MANSCEN construction will be commensurate with training facilities now on Fort Leonard Wood. Buildings will be all brick with

architectural designs complementing existing structures. The well-planned and coordinated consolidation of the Engineer, Chemical, and Military Police Schools at Fort Leonard Wood will ensure that the MANSCEN stands as TRADOC's model cluster installation.



Major Herold serves as the Military Police representative for Base Realignment and Closure (BRAC) actions at Fort Leonard Wood, Missouri. Previous assignments include S3 and XO of the 793rd Military Police Battalion, Germany and Bosnia; Management Directorate, Office of the Chief of Staff of the Army; and recorder for the Secretariat for DA Officer Selection Boards.

Major Wilson is the U.S. Army Chemical School commandant's representative on the Fort Leonard Wood BRAC staff. Previous assignments include battalion chemical officer, 2-32 Armor, 3 AD; decontamination platoon leader, 22nd Chemical Company; brigade chemical officer and battery commander, 35th ADA Brigade; instructor/writer, Combined Arms Branch, U.S. Army Engineer School; and Chief, Chemical Branch Assistance Team, 5th U.S. Army Readiness Group.

The Total Army School System

By Major Larry Cerny

Over time, each of the three components of the Army—Active, Reserve, and National Guard—developed independent school systems, which gradually developed separate standards. The new Total Army School System (TASS) creates one system with identical tasks and standards for all three components.

The Engineer School's mission is to complete a transition to an effective and efficient TASS of fully accredited and integrated Active, Reserve, and National Guard schools that provide standard engineer institutional training and education for America's Army.

Organization

To understand this mission, we must first understand the TASS organization. The Continental United States is divided into seven regions, labeled A through G (Figure 1). TASS implementation began in 1994 with the standing up of Region C, which was used as a test bed. The other regions were activated in October 1996.

Implementation of this new system creates the following major changes:

- U.S. Army Reserve Force (USARF) schools were replaced with school battalions.
- Total Army Training System (TATS) courses are replacing Reserve Component Configured Courseware (RC3).
- Proponents are responsible for instructor certification.
- Proponents are responsible for accreditation of the school battalions.

Each school battalion is functionally aligned with a proponent school. Functional alignment is "a branch school's functional relationship with its affiliated Reserve Component training institutions and instructors, which provides current concepts, techniques, and equipment for that branch's courses." For example, the Engineer School, located at Fort Leonard Wood, Missouri, is functionally aligned with the seven Engineer School battalions.

In addition to their functional alignment, the school battalions have a command alignment (Figure 2, page 45).

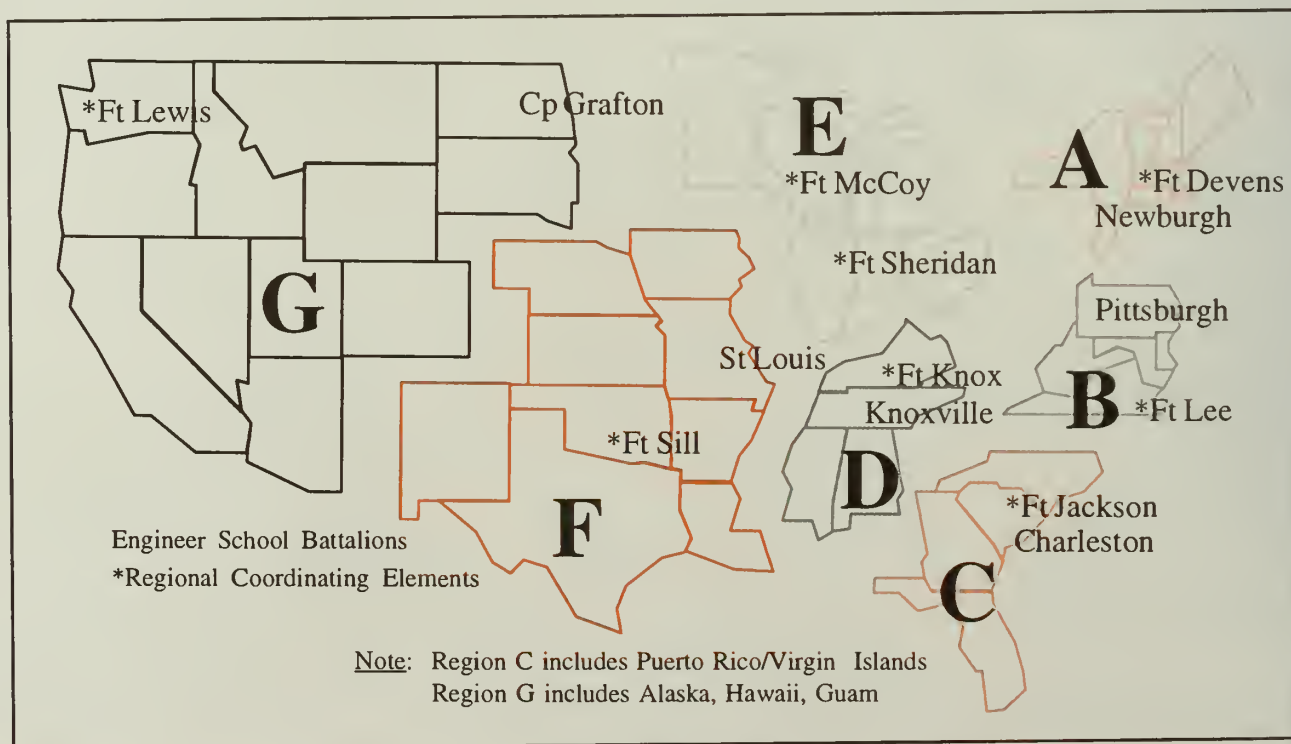


Figure 1. TASS regions

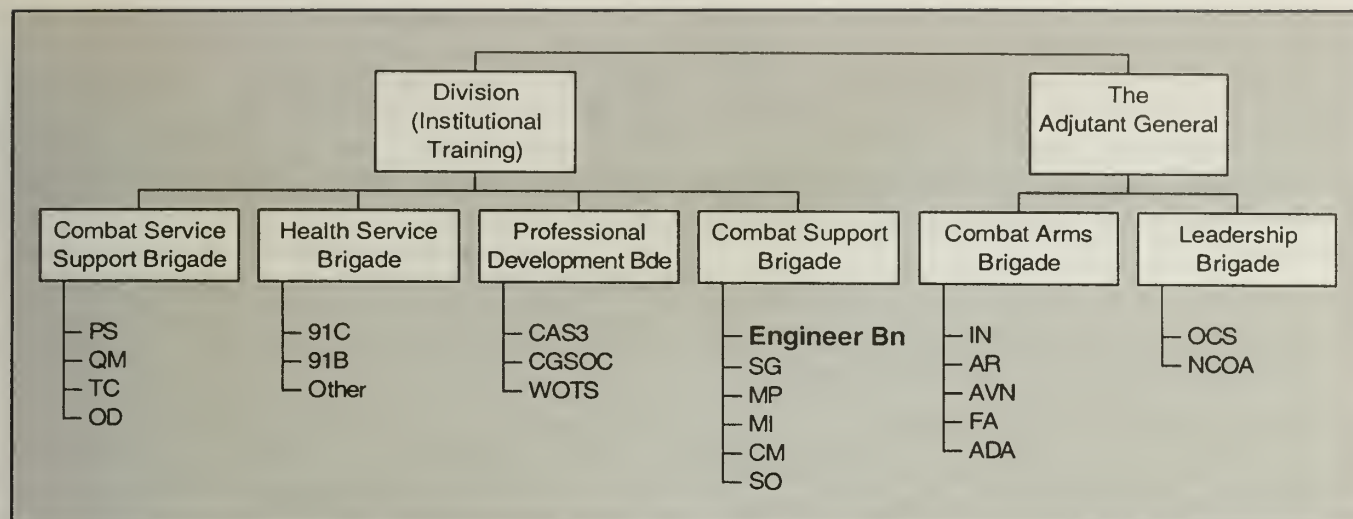


Figure 2. Command alignment of school battalions

School battalions report to school brigades. Combat arms and leadership brigades report to the Adjutant General (TAG). Combat service support, health service support, professional development, and combat support brigades report to reserve divisions.

The Engineer School's Department of Training and Doctrine Development created a TASS Division to control all the functions that TASS dictates. The division is responsible for the following areas:

- Codeveloping individual training courses with the Training Development Division.
- Maintaining functional alignment with the Engineer School battalions.
- Accrediting the Engineer School battalions.
- Maintaining a central point of contact concerning TASS issues.

Each of the seven TASS regions has a Regional Coordinating Element (RCE) that is staffed with Active Component, full-time Army Reserve, and full-time National Guard soldiers. They are a TRADOC element charged with being the overall TASS coordinator for their respective region.

"Title XI," the congressional action that authorizes and requires the use of active duty personnel for dedicated support of reserve units, supports the TASS structure. Title XI personnel are assigned to RCEs, proponent schools, and the Reserve Component school battalions.

TATS Courses

These selected courses are designed for military occupation specialties (MOSSs) within all Army components.

Although the training may occur at different sites and may use different media or methods, a TATS course trains all critical

tasks to a common performance standard, including those for Department of the Army and TRADOC-directed courses.

Reserve Component soldiers normally have 16 hours of inactive duty for training (IDT) each month. They meet one weekend a month or once a week for 4 hours. In addition, they normally have a 14-day annual training (AT) period.

In the past, Reserve Component Configured Courseware was taught in U.S. Army Reserve Force schools. This courseware included only those tasks needed to prepare reservists for mobilization, not necessarily all the tasks for which active duty soldiers trained. Performance standards for each component differed. Trade-offs were made for reservists because of their time constraints.

TASS changes this process. Now one standard course replaces the separate Active and Reserve Component courses. Instead of the Training Development and TASS Divisions working independently, they work together to develop a product that fits the needs of both components.

Instructor Certification

Under TASS, proponent schools certify the Reserve Component instructors who teach in the school battalions. Each proponent school has a battalion in each of the seven regions. The Engineer School has a battalion in the following locations:

- Region A—Newburgh, New York
- Region B—Pittsburgh, Pennsylvania
- Region C—Charleston, South Carolina
- Region D—Knoxville, Tennessee
- Region E—Fort Sheridan, Illinois
- Region F—St. Louis, Missouri
- Region G—Camp Grafton, North Dakota

The school battalions send instructors wherever they are needed. For example, if a military unit located in southern California needs a course taught during IDT, the engineer battalion at Camp Grafton selects a Reserve Component instructor near that site to instruct the course.

Under TASS guidelines, the following certification standards apply to both Reserve and Active Component instructors:

- Meet mandated soldier requirements for height, weight, Army Physical Fitness Test, and security clearance.
- Have the MOS of the course being taught.
- Graduate from the course, be a subject matter expert (certified for specific blocks or lessons only), or test to proponent school standards.
- Graduate from an Instructor Training Course.
- Demonstrate teaching competence.
- Meet the specified minimum grade level for teaching the course.
- Fulfill additional proponent school requirements.

Certification requirements must be achieved in one Reserve Component training year, which equals two AT weeks and 12 IDT weekends. Together, AT and IDT will not exceed 39 training days.

School Battalion Accreditation

Beginning in FY98, and every three years thereafter, an accreditation team from proponent schools will evaluate the school battalions that are functionally aligned with them. The team will consist of a team chief, an evaluator, and a subject matter expert. Accreditation requirements involve two major areas: administrative procedures and records, and conduct of training. In the evaluation process, the team will use checklists that cover the following:

- Quality of instruction.
- Use of qualified instructors.
- Adequacy of facilities and equipment.
- Procedures to ensure that students meet established prerequisites.
- Compliance with approved programs of instruction and governing regulations.

To accredit a school battalion, proponent schools must evaluate one annual training period and at least one-third of the inactive duty training periods.

Distance Learning

Distance learning (DL), although separate from the other TASS responsibilities, plays a key role. DL applies multiple means and technologies to deliver standardized training to soldiers and units at the right place and time. At the center of DL is Classroom XXI, an Army initiative to place high-tech classrooms throughout the military community. The current TRADOC plan calls for fully implemented DL by the year 2010. By that time, TRADOC expects that 66 percent of our soldiers will receive DL and that 99 percent of our soldiers in the continental United States will be located within a 1-hour drive from a DL facility.

Conclusion

The TASS affects all Army soldiers. They can either attend training at the Active Component Teaching Institution (ACTI) or one of the Reserve Component school battalions. However, all initial-entry training occurs at the ACTI. No matter where they are located, the Army courses teach the same tasks and standards and are taught by instructors with identical certification standards.

To make TASS work for the engineer community, we need feedback on what is working and what needs to be improved in our individual training courses. Whether you are an Active, Reserve, or National Guard soldier, these are your courses and TASS is your school system, so send your ideas to: Commandant, U.S. Army Engineer School, ATTN: ATSE-TD-TASS, Fort Leonard Wood, Missouri 65473; or via email: cernyl@wood-vines.army.mil. The telephone numbers are: DSN 676-4114; commercial 573-563-4114.



Major Cerny is chief of the Schools Branch, TASS Division, DOTD, U.S. Army Engineer School. Previous assignments include training officer, 98th Division (Institutional Training); assistant S3, 367th Engineer Battalion (Combat Corps); and training officer/platoon leader, 760th Engineer Company (Combat Support Equipment).

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1. Total Army School System (TASS) OPLAN-2. TRADOC. 1 January 1995.
2. TRADOC Regulation 350-70, *Training Development Management, Processes, and Products*. 24 September 1995.
3. TRADOC memorandum, subject: *Total Army Training System (TATS)*. 25 March 1996.
4. TRADOC memorandum, subject: *Policy for Certifying Instructors*. 20 November 1995.
5. TRADOC TATS/DL Workshop. 29 April - 2 May 1996.



Engineer Solution

1. Use the equations on page 37 of the Ice Bridging article to determine the military load classifications:

C = 0.9 (Semiclear)
S = 0.6 (Freeboard less than 90 percent)
T = Thickness of ice (in inches)
W = Wheeled vehicle MLC
A = Tracked vehicle MLC

$$W = \frac{(T^2)CS}{25} = \frac{(43)^2(0.9)(0.6)}{25} = 39.9 \text{ (round down)} = 39$$

$$A = \frac{(T^2)CS}{20} = \frac{(43)^2(0.9)(0.6)}{20} = 49.8 \text{ (round down)} = 49$$

Answer: The MLC for wheeled traffic is 39, and the MLC for tracked vehicles is 49. Vehicles will be spaced 150 feet apart (up to two vehicles may be on the ice at a time).

2. The MLC for an M1A1 tank is 70. To determine the ice depth required from the equation, complete the following:

$$\text{Thickness (inches)} = \frac{A(20)}{C \times S} \text{ or } \frac{70(20)}{CS}$$

$$\text{Thickness (inches)} = \frac{70(20)}{0.9 \times 0.6} = 50.9 \text{ inches (round up)} = \text{minimum ice thickness of 51 inches.}$$

Answer: There are currently 43 inches of ice over the river and 51 inches are required to safely cross the M1A1 tank. Therefore, 8 inches of ice must be added. Since 2 inches of ice may be added to the bridge per day, it will take 4 days to reach the desired strength.

Alternative Solution

The problem also can be solved by using the Quick Reference Card and Graph shown in Figure 3, (page 36) and Table 3 (page 37). They are used when time does not allow for a deliberate recon on the crossing site. The deliberate method gives a different answer because detailed information is known about the ice and safety factors are included in the calculations. When using the quick method, normally only the ice thickness and ambient conditions are known. The ice color and strength factors are not considered when determining a solution but can be added to further define the crossing site conditions. When time allows, a complete recon and ice-bridge profile should be completed.

1. It is given that the ice is 43 inches thick and the heaviest vehicle crossing the bridge is an M1A1 Abrams tank (MLC 70). Reading down column 1 on the Field Guide Quick Reference Card (Table 3) to MLC 70, the minimum thickness required is 34 inches and the required distance between vehicles is 280 feet.

2. The reference card indicates the ice will support MLC 70 vehicles, and further strengthening of the bridge is not required. Note the 280-foot spacing between vehicles, indicating that only one vehicle may cross the bridge at a time. The wear surface and approach and exit banks will require occasional maintenance.



The Engineer Jungle Warfare Course

By Captain Andrew V. Jasaitis

The Jungle Operations Training Center (JOTC), located at Fort Sherman, Panama, trains infantry battalions and engineer companies to conduct jungle combat operations. One of the programs offered by JOTC is the Engineer Jungle Warfare Course (EJWC).

The EJWC provides a unique opportunity for engineer companies and platoons to train in a jungle environment. The Jungle Operations Training Battalion normally supports four engineer company and ten engineer platoon rotations annually. The EJWC is open to almost any combat engineer company—airborne, air assault, wheeled, combat support equipment, combat heavy, etc. Most rotations are from corps-level engineer companies because divisional engineer platoons deploy and train with the Infantry Battalion Jungle Warfare Course rotations.

The Jungle Operations Training Center's primary objective is to keep the art of jungle warfare alive in the Army today. In concert with this mission, the Engineer Jungle Warfare Course prepares engineers to fight future battles and win in a jungle environment.

In addition to supporting U.S. Army combat engineers, the Engineer Jungle Warfare Course provides joint training to selected U.S. Marine Corps engineer platoons and some Latin American engineers.

Program of Instruction

The program of instruction for the EJWC is organized, manned, and equipped to provide training to three engineer platoons. Instructors from Alpha Company, Jungle Operations Training Battalion, conduct the training by committees. Team 6 provides instruction in engineer-specific tasks.

The four-week EJWC consists of two weeks of combat training (core jungle training and tactical operations) and two weeks of construction (Army Facilities Components System-Tropical).

Combat Training. Typical training during the first two weeks includes: jungle living, land navigation, mines and booby traps, jungle combat techniques, rappelling, advanced rigging and hauling, squad reconnaissance, squad react-to-contact (blank and live fire), waterborne and small-boat operations, basic and advanced demolitions, and platoon reconnaissance and demolition missions. Platoons also negotiate the rugged "Green Hell" obstacle course. The second week culminates in a two-day company field training exercise designed to meet the unit's mission essential task list (METL) training needs and to employ tactics, techniques, and procedures learned during core training. Company infiltration



An engineer squad from B Company, 27th Engineer Battalion (CBT) (ABN) conducts a reconnaissance mission on the Chagres River.

and movement is by several methods—landing craft, medium (LCM); F-470 Zodiacs, or Army aviation (air assault).

Construction Training. The third and fourth weeks of the course are spent on construction missions, which include carpentry, concrete and masonry, plumbing, and construction management tasks. Projects include bridge repair or replacement; target, rappel tower, obstacle, boat dock, fence, cage, and roof construction; office and classroom renovation; and window installation. Units normally provide eight days of construction effort. All projects are designed to support the training center so that the Jungle Operations Training Battalion can continue to provide high quality training opportunities.

Deployment Tips

Adequate planning is important for a successful deployment to the Jungle Operations Training Center. The following tips will help units planning to attend:

- Send a site survey team six months before deployment. The team should consist of two or three people who can make decisions on training and who have a working knowledge of construction.
- Allow five days (Monday through Friday) for the team's visit—two travel days, one day on the Pacific side, and two days at Fort Sherman for coordination.
- Plan for the main body to arrive on the Friday or Saturday before the first training day on Monday.
- Plan for the advanced echelon to arrive four days before the main body.
- Deploy with all necessary construction equipment (such as sets, kits, and outfits; power tools; and generators).
- Plan to be self-sufficient (special equipment will be coordinated in-country if needed).

- Focus home-station training on knots/rope management, basic land navigation, and battle drills in dismounted movement/patrolling at squad and platoon levels. Identify weak swimmers (water safety and drown-proofing classes must be conducted within three months of deployment).
- Units that conduct airborne operations must conduct B-7 training and request permission to jump in country.

Benefits

The benefits of a deployment to EJWC are many. Engineers receive METL-related training in deployment and numerous collective, leader, and individual tasks. The decentralized training allows squads to train soldiers and develop or improve standing operating procedures. Units can identify strong and weak performers as well as build teamwork and cohesiveness. Soldiers are allowed to make mistakes and train to standard without the pressures of higher headquarters. The Jungle Operations Training Battalion provides almost all training support, so that leaders can concentrate on meeting training objectives. Most of all, engineer units increase proficiency and gain confidence in conducting operations in a harsh jungle environment.

Engineer units should contact Forces Command for scheduling and funding to attend the Jungle Operations Training Center. Under the current Panama Canal Treaty Implementation Plan, Fort Sherman will remain open until the end of 1999. For more information, call the Jungle Operations Training Battalion engineer at DSN (313) 289-6411; Team 6, A Company, (313) 289-6057; or the S3, Jungle Operations Training Battalion, DSN (313) 289-6287.



Captain Jasaitis served as the senior engineer instructor-observer/controller at the Jungle Operations Training Center, Fort Sherman, Panama, from February 1995 to May 1996.



Precast Demolitions Training Range Bunkers

By Gerald L. Knapp and First Lieutenant Adrian Donahoe

Today's Army continually changes its training to fight different types of conflicts. Adjusting training is relatively easy, but adjusting training sites is not. It is difficult to move existing ranges, establish new ranges in a cost-effective way, identify range fans and safety or buffer areas, build new support facilities, and redefine impact areas while maintaining good environmental stewardship. Units must often adjust to the loss of training areas and the proverbial "doing more with less" situations. This article describes how the United States Military Academy successfully designed and installed a new demolitions training range bunker using state-of-the-art concrete technology.

Mission

The planning process for 1996 cadet field training revealed the need for more light infantry training and a larger training area. Since acquiring more land was not an

option, we decided to maximize the use of existing training areas.

The demolitions range occupied prime areas needed for light infantry training. Range control personnel selected an alternate site adjacent to the existing artillery impact area and moved the demolitions range there. The impact area provides a safety zone around the new demolitions training site, which is an added benefit.

Overall design of the demolitions range was driven by the requirement to allow cadets to witness detonation of the demolitions charges they prepared. Since this was the third site for the demolitions range in five years, ease of construction and portability were primary issues.

While reviewing sales literature for precast concrete bridge spans for use in our range and training complex, we discussed whether these spans might also provide overhead cover protection for the range. We contacted the

manufacturer, who indicated that a concrete precast bridge span had never been used for a bunker. We reviewed the construction details of the proposed unit and decided it would meet our needs. The manufacturer sent shop drawings, which were presented to members of the U.S. Military Academy Range Review Board. This group of trainers, range control managers, the Director of Housing and Public Works, and environmentalists routinely meet to plan and track range improvements. They approved our plan as presented.

Specifications

The bunker is made from four precast concrete pieces. The floor is two panels, each 9 inches thick, 21 feet long, 6 feet 6 inches wide, and weighing 7.8 tons. The panels are reinforced with Number 6 and Number 4 rebar. They are joined with a keyway filled with fast-setting construction grout.



A completed bunker built with precast concrete.

The 10-inch-thick reinforced end wall is 37 feet long and weighs 14 tons. It has three windows that are 6 feet long, 2 feet 6 inches high, and 2 inches thick. They are multilayered (laminated glass, polycarbonate, and lexan) and bullet-resistant to meet Army specifications. These are basic embassy windows that will resist 15 minutes of forced entry and impacts from three 7.62-millimeter rounds in an 8-inch circle. This is more than sufficient to stop fragments that may result from demolitions training. A replaceable scar shield of 1/4-inch Plexiglas protects both sides of the windows from vandalism and fragments.

A bridge span that is 38 feet long, 9 feet high at the apex, and 6 feet 6 inches deep provides overhead cover. It weighs 25 tons and is connected to the end wall at six points with 6-inch by 6-inch angle iron bolted to drop-in anchors installed during casting.

Construction

To prepare the bunker site, an engineer platoon removed existing mortar pits, moved a set of bleachers, removed the existing range tower, and hauled suitable fill for

the walls of the demolitions pit.

The foundation has a 12-inch-high base of 3/4-inch stone to ensure good drainage around the bunker. The base is held in place by a curb made of 2 by 10 lumber and rebar. This is strengthened by backfilling around the curb with more stone.

The bunker arrived on three flatbed trucks at 1000 hours and was in place by 1800 hours. The following day the engineer platoon grouted the joints between the span and the base and caulked the arch/end wall joint.

Personnel from the Directorate of Housing and Public Works installed the windows, which were mounted with 3-inch angle iron on both sides. They used sheet steel to shim the windows and fill the voids around them.

Cost Effectiveness

The total cost for the project was approximately \$30K (see table). This sounds expensive for a bunker, but it is portable. If the demolitions site is moved, the bunker can go with it. It has an expected life span of at least 20 years.

Moving the "portable bunker" will be relatively easy. It requires fracturing the grout, unbolting the 6-inch angle iron

connectors, removing the windows, and transporting the bunker to the new site. We left the lifting point exposed to facilitate rigging when the unit is moved.

Cost of Precast Bunker

Item	Cost (K)
Precast bunker parts	\$19
Windows	6
Crane and rigging	4
Site preparation	1
Total	\$30

Moving and consolidating ranges to meet financial and environmental constraints is a fact of life in our current downsizing phase. By using state-of-the-art construction materials creatively in our training areas, we help ensure that training is effective for soldiers, friendly to the environment, and cost effective for the tax payers.



Mr. Knapp is the operations officer, Directorate of Housing and Public Works, U.S. Military Academy.

First Lieutenant Donahoe is the engineer platoon leader, U.S. Military Academy.



CTC Notes



National Training Center (NTC)

Using Obstacle Group Designs

By Major Tom Buning

The last submission of *CTC Notes* from the National Training Center (August 1996) focused on the combat engineer platoon's role as executors. It emphasized that improvement in engineer platoon productivity in countermobility tasks requires taking action at all levels to narrow the platoon's focus in the defense to siting and emplacing minefields. Lessons learned at the NTC show that poor planning products at the engineer battalion and company levels are a primary cause of poor obstacle execution. This article provides a technique to produce an executable plan for the platoon leader as a way to improve productivity and support to the mission.

To provide an effective link between obstacle planning and execution, engineers need a tool that focuses the effort of the former to improve the efficiency of the latter. It is not sufficient to hand a set of obstacle graphics to a platoon leader and expect that a plan will be executed to a standard that

either meets or supports the maneuver commander's intent. A recommended technique for providing the details required for timely execution is to introduce into the planning process an obstacle group design that includes each directed obstacle. (Note: Most tactical obstacles at the task-force level are directed; some may be reserve or situational.) Planners must provide a level of detail in the obstacle group design that enables platoons to emplace obstacles that meet the commander's intent.

Task force engineers (engineer company commanders) must produce an obstacle group design overlay that provides the following information as a minimum:

- Tentative layout of the obstacle group depicted on a 1:25,000- or 1:12,500-scale map showing (to scale) the size, shape, location, and orientation of each obstacle.
- Operations graphics showing the applicable engagement areas, battle positions, and target reference points.
- Various terrabase pictures from both friendly (key direct fire systems) and enemy (engagement area) perspectives.
- Text, including both the resources and effort required to execute the obstacle group and any special instructions. This information tells the platoon leader what he is siting, the effort he must commit to the project, and the expected duration of the effort.

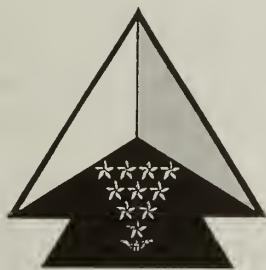
Production of an obstacle group design will force planners to more clearly understand the effort they are committing as they lay out the details of a directed obstacle group. It also forces planners to clearly and accurately define the Class IV/V requirements needed to integrate obstacles into the combat service support plan. *Commitment* is the key word. The value of preparing an obstacle group design is that it forces planners to provide the level of details required for the platoon to execute the plan. It also provides the capability to more accurately track the precious platoon hours and resources needed to accomplish the plan. The countermobility/survivability time line used to track planned versus executed performance enables engineer staff officers to better inform the chain of command on the status of building the defense.

Successful execution of an obstacle group design by task force engineers requires a task organization constraint. Engineer platoons cannot be placed in direct support to a maneuver company and remain effective in their ability to execute the plan established by the assistant and task force engineers. Therefore, combat engineer companies cannot be task organized beyond direct support to the supported task force. This does not mean that the engineer platoon leader is relieved of the responsibility to properly coordinate with the maneuver company team that owns the engagement area where they are constructing an obstacle group.

From a current doctrinal perspective, use of an obstacle group design fills a void. FM 90-7, *Combined Arms Obstacle Integration*, establishes that task force engineers (engineer

company commanders) are responsible for planning. FM 20-32, *Mine/Countermine Operations*, recommends an obstacle group design method as an initial step toward establishing a framework for emplacing obstacles, while FM 90-7 states that a platoon leader executes intent. This is where doctrine fails to discuss in detail the need to produce a detailed plan or the important role of the engineer platoon as its executor. In fact, chapter 5, FM 90-7, warns that given a plan with too much detail, a platoon leader will emplace minefields as articulated in concept and disregard proper obstacle siting. Given this line of thought, it may be argued that use of the obstacle group design will increase the problem of improper obstacle siting, because this technique places greater emphasis on precise design/execution standards. However, NTC engineer trainers submit as a strong counterpoint that, for efficiency in execution, it is a lesser training challenge to make lieutenants and platoon sergeants understand that they must site obstacles and adjust a given design to the terrain than to generate the design itself.

The goal of these two submissions from the NTC (August 1996 *Engineer* and this article) is to ensure that engineer leaders and staff officers manage the precious time available to engineers in establishing the defense. The most effective way to accomplish this is to prepare an executable plan that allows for the efficient use of engineer platoon hours. It is not sufficient to point out a problem without suggesting a solution. This article provides a technique (the obstacle group design) that will narrow the focus of the platoon to its organizational capabilities and instill discipline into obstacle emplacement. Disciplined execution of an obstacle plan will allow our combat engineer force to maintain its credibility as a member of the combined arms team. It will enable us to deliver what we promise—obstacle effects on the ground to shape the fight for the commander. With victory as the only acceptable alternative, there is no other choice.



Battle Command Training Program (BCTP)

By Lieutenant Colonel David Snodgrass

Recent BCTP Warfighter exercises show that targeting enemy capabilities presents a significant challenge for divi-

sions. Complete targeting of an enemy capability almost always requires a combined arms operation. If successful, it provides an excellent opportunity to upset the opposing force (OPFOR) plan and time line and improve our position on the battlefield. For example: Some divisions use air interdiction (AI) missions to destroy fixed bridges over rivers deep in the enemy rear area, theoretically to slow enemy follow-on echelons and force him to expend various critical resources (time, bridging, and engineer effort). Unfortunately, they target only the fixed bridges and not the full spectrum of components that comprise the enemy force and its capability to move rapidly across a river. The usual result is only a minor inconvenience to the OPFOR and has little impact on their overall plan.

Consider for a moment how rare and valuable AI missions are and the risks we take to fly behind enemy lines to hit bridges. Are we accomplishing our objective if we fail to track the movement of the enemy force, interdict the bridges too early, or allow the enemy sufficient time to change routes without delaying his time line? Worse yet, what if we hit the bridges after he has already crossed? Assuming that the enemy's bypass options are difficult, how effective is knocking out a bridge if we fail to detect or target enemy engineer bridge units located near the bridge? How effective is the action if we fail to dedicate reconnaissance assets to watch the damaged/destroyed fixed bridges and detect his attempts to construct float bridges or repair the damaged fixed bridges? Have we maximized the delay time of the enemy force if we allow enemy engineers to work unimpeded? If we do not dedicate additional reconnaissance efforts to identify and report the enemy maneuver elements stacked up on routes into the crossing area, or if we do not dedicate assets to strike "target rich" environments, have we fully realized the maximum benefit of our actions? If we lose aircraft and pilots on the AI mission and the enemy has bridges up and forces moving again within a few hours, was the cumulative effect worth our efforts?

Our best option is to hit the enemy, specifically his capability to rapidly move forces across a river, with multiple problems from multiple directions and present him with more than one challenge to solve at any given time. Doctrine states and experience shows that an obstacle is effective only when it is combined with other types of obstacles and integrated with planned, dedicated direct and indirect fires to achieve a specific effect. To accomplish this, we must attack the spectrum of assets that comprise the enemy capability as well as the enemy forces. We must remove his ability to use fixed bridges, take away his crossing alternatives and bridge-repair capability, consider other means to make an obstacle complex (i.e., Gator minefields), and then strike his forces as they wait for an opportunity to move forward.

Division decision makers, in this case the combined arms

deep operations coordination cell (DOCC), need a cost-benefit analysis to assist their decision making. After we clearly define the desired effect, we should clearly identify the targeted capability, component pieces, and resources required; determine if the resources are available and in the proper position; and quantify the risk associated with the mission. Once this analysis is complete, the decision makers will clearly understand the challenges involved in the mission. Then they can determine if the committed resources and risks involved are worthy of the net effect gained over the enemy. Planners should brief the division commander on the high-risk operations that commit limited resources, potentially impact other operations, or have a potential payoff that is not clearly in our favor to assist him in the decision to execute an attack.

AI missions against bridges are one example of this concept using the mobility/survivability battle operating system (BOS). Enemy capability targeting challenges are found all across the battlefield, in each of the BOSs, and require a combined arms effort for success. Complete targeting of an enemy capability provides a much greater opportunity to significantly impact the OPFOR plan, presents the enemy with more than a minor inconvenience, and significantly improves our position on the battlefield.



Joint Readiness Training Center (JRTC)

Minefield Battle Tracking and Influencing the Low-Intensity Fight

By Captain Jeff Farnsworth

Enemy minefield battle tracking is an improving trend for units rotating through the JRTC. Successful units expend considerable effort to ensure their minefield-tracking charts and feeder reports include the information elements needed to show the mine threat across the battlefield. Many units disseminate minefield feeder reports widely and post them in all vehicles throughout the brigade. The flow of obstacle intelligence (OBSTINTEL) from subordinate units is improving, although the accuracy and timeliness of reporting still need attention. Detached engineer platoons are getting better at flipping the switch on their SINCGARS and reporting minefield incidents to the engineer company/brigade engineer cell as they occur. Engineer conference calls facili-

tate information flow to confirm/deny other OBSTINTEL at the brigade level. The engineer at the brigade level is better integrated with the intelligence and maneuver battlefield operating systems (BOSs). Most OBSTINTEL is captured and posted. Brigade engineers consistently confirm/deny and exchange information with the S2. These actions are positive indicators that systems are in place for commanders to "see" the battlefield. They set the stage for the application of battle command in the countermine fight.

To increase the effectiveness of their combat operations, units should focus training efforts on the dissemination and analysis of battlefield information. Some successful techniques follow:

Dissemination. Units typically disseminate updated minefield tracking reports as an engineer annex to daily brigade fragmentary orders. Most successful units ensure this information is quickly passed to company and platoon levels, where it is integrated into current operations. This technique, however, does not allow for rapid dissemination on a fluid, nonlinear battlefield. As minefield incidents occur, consider sending "flash minefield reports" over command nets, in much the same way that units disseminate flash NBC reports. This technique provides subordinate units and small unit leaders immediate access to this critical information and enhances their situational awareness.

Analysis. The brigade and task force engineers who are able to influence the maneuver targeting process experience significantly more success against an austere enemy than those who are not. Sharing, confirming/denying, and disseminating information is not enough. Engineers also must aggressively influence the S2's analyses and ensure that updated situational templates accurately reflect the relationship between enemy activity and disposition to OBSTINTEL. The engineer must advise and assist the S2 in adjusting templated caches, supply transfer points, and, therefore, likely enemy unit locations. Jointly with the S2, update the S3 on the current enemy situation. This information helps focus the intelligence picture used in targeting meetings at brigade and task-force levels. Engineers typically are passive observers during the targeting process. Instead, they should—

- Recommend a focused area around high-density enemy minefield activity for designation as named areas of interest and high-priority targets.
- Recommend using scouts and other intelligence assets to monitor enemy activity in these areas.
- Recommend that counterreconnaissance efforts and ambushes be employed near reseeded minefields.

By employing a combination of these efforts, engineers will assist maneuver commanders in exercising effective battle command to win the countermine fight.

War With Mexico: The Northern Campaign, 1846-1847

By Paul K. Walker

In the mid-1840s, the United States and Mexico went to war over the annexation of Texas as a state and an unresolved boundary dispute. Mexico claimed the Nueces River; the U.S. claimed the more southerly Rio Grande.

As the crisis worsened, the U.S. Army readied for possible hostilities. Authorized strength was only 8,500, but in 1845 considerably fewer men were available for service. The situation resulted from a long period of relative peace and traditional bias against standing armies and large military budgets in favor of the militia.

The Army's engineers were organized in two corps—a Corps of Engineers and a Corps of Topographical Engineers. The Corps of Engineers, under Colonel Joseph G. Totten, numbered 43 officers; the Topographical Engineers, under Colonel James W. Abert, numbered 36. The top graduates of West Point filled their ranks. Indeed, a West Point education was a unifying factor among the engineers who served in the war with Mexico.

By the 1840s, the Corps of Engineers' primary duties involved coastal fortifications, while the topographers (topogs) were engaged in river and harbor improvements, road building, Western exploration, and mapping. Neither corps had a troop unit assigned to it and had to rely on soldiers detailed from other branches and hired civilians.

In June 1845, President James K. Polk ordered Brevet Brigadier General Zachary Taylor to move his forces from Louisiana to Texas. Taylor first set up camp on the Nueces River at Corpus Christi (on the northern edge of the disputed territory). By fall his force numbered 4,000, about two-thirds of the actual strength of the entire regular Army. Initially Taylor had two engineers and three topographers with him.



Second Lieutenant George G. Meade, a topographer, was one of them.

After a diplomatic mission failed, President Polk ordered Taylor to move through the disputed territory to the Rio Grande. On 8 March 1846, Taylor set out for Matamoros. Captain Jared K. F. Mansfield led the reconnaissance and selected camp sites along the 150-mile route. After they reached the north bank of the Rio Grande, across from Matamoros, there was little rest for the engineers. The topographers reconnoitered the surrounding area, while Mansfield directed construction of a 6-bastioned earthen fortress capable of holding 2,000 men and their horses.

The stage was set for conflict. On 24 April 1846, Mexican forces ambushed an American patrol, killing or wounding 16 soldiers. Two battles followed in early May. One, at a watering hole called Palo Alto on

the way to Matamoros, gave Lieutenant Jacob Blake (a topographer), his moment of glory. Blake volunteered to inspect the enemy's positions. An artillery captain described the action: Blake "dashed off from the right of our line to within musket-shot of the enemy's left. Here he dismounted, and with his field glass coolly counted the number of men in one of the enemy's squadrons, which of course enabled him accurately to estimate the enemy's entire cavalry force. Blake then remounted his horse and galloped from left to right of the enemy's line, stopping from time to time and carefully observing the formation and number of his infantry, as well as the position, number, and calibre of his field guns, all of which information was fully verified by the subsequent events of the day." Blake's report helped the outnumbered Americans prevail.



In official reports, maps, and drawings, the Topographical Engineers of the Mexican War period helped detail the wonder and beauty of a vast, previously unknown territory. Lieutenant James Abert's sketch of Cheyennes is an example.

Meade also described his role at Palo Alto: "I was in the action during the whole time, at the side of General Taylor and communicating his orders. I may justly say I have had my '*Baptem de feu*!' An officer of the general's staff had his horse shot under him, not two yards from me, and some five horses and men were killed at various times close to me." The Mexicans retreated, but Taylor encountered them again the next day a few miles south at Resaca de la Palma. In what amounted to a pitched infantry battle, experienced American regulars and the skilled leadership of junior officers helped carry the day.

After the two battles, Taylor commended Blake and Meade, as well as Lieutenant Wood, another topographer, who helped set up and fire the artillery's 18-pound cannon at Resaca de la Palma. In those two days of battle, American casualties totalled 175, with less than 40 killed, and Mexican casualties numbered 1,000.

The Mexican army retreated across the

Rio Grande to Matamoros, but Taylor did not pursue them. He was outnumbered and lacked equipment to cross the river. The delay frustrated Meade. In his view, Taylor had the time but did not know how to use his staff, especially his engineers. "Had Taylor known," Meade wrote, "he would have had us at work experimenting and when any plan proved successful, had a bridge constructed and put in depot, and then on the tenth (of May), in three or four hours, the whole army, artillery and all, could have crossed and the Mexican army been prevented from retreating with some twelve pieces of artillery." By the time the American soldiers crossed the river eight days later, using captured boats, the enemy had withdrawn. Matamoros belonged to Taylor, but the Mexican army remained alive.

Slow communications kept word of the 24 April attack and American deaths from President Polk until the evening of 9 May. That news was all he needed to obtain a declaration of war from Congress, along with \$10 million, an increase in authorized

Army strength to 18,000 by expanding existing units, and authority to raise 50,000 volunteers.

On 15 May 1846, Congress established a 100-man company of sappers, miners, and pontoniers whose duties included assisting laborers in erecting fortifications and then supervising the finished fortifications. The company was to consist of 10 sergeants, 10 corporals, 78 privates first and second class, and two musicians. This unit was the forerunner of today's 1st Engineer Battalion, stationed at Fort Riley, Kansas.

For years, Chief Engineer Totten had argued in vain for such a company. Commanding General of the Army Winfield Scott, a staunch admirer of the engineers, had echoed his support. But it took a declaration of war to win Congressional approval.

Even so, preparations had been underway at West Point. From the faculty, Captain Alexander Swift was designated for command and had already spent two years at the French school of military engineering at Metz. When Congress acted, Swift

selected Lieutenant Gustavus W. Smith, a fellow faculty member, as his second in command. Experienced in company administration and infantry drill, Smith complemented Swift's technical expertise. As the third officer for what would be known as Company A of Engineers, they selected George B. McClellan, a soon-to-graduate cadet.

The three officers immediately began the challenging job of obtaining equipment and recruiting and training men. Totten's instructions were specific: "We must have smart, able-bodied young men, who can read and write, and have knowledge of a relevant mechanical trade." He urged Swift not to recruit married men and naturalized citizens and declared that, except for the musicians (buglers), their minimum height should be 5'6" with preference for those 5'8" to 5'10."

Promotions in the Army were rare. Lacking a retirement program and a mandatory retirement age, senior officers stayed on and many were too old to serve in the field. McClellan was ecstatic to be graduating and immediately going to war. "Hip! Hip! Hurrah!" he wrote home. "Ain't it glorious!" George Derby, another member of the class of 1846 who joined the topographers, wrote to his mother, "Nothing is heard but promotion, glory, and laurels."

Still, recruitment was slow. The company never reached full complement and waited until 12 September for orders to join Taylor's army in Texas. Finally on 26 September, 3 officers and 71 enlistees with basic training at West Point under their belts, sailed from New York harbor. All but two were native-born. Only four had previous military experience. After arriving in Texas in December, Company A moved to Tampico and became involved in preparations for Vera Cruz.

Meanwhile Taylor's army in Texas grew by adding new recruits, volunteers, and topographers. Captain William G. Williams was fresh from the Great Lakes survey when he became Taylor's chief topographic engineer.

In early August, Taylor started for his next objective—Monterey, the capital of the Mexican province of Nueva Leon,

which had a population of 10,000. His engineers accompanied an advance party to reconnoiter and repair the roads. As Taylor drew near, Captain Mansfield's party obtained information on the city's defenses. Based on Mansfield's findings, Taylor decided to cut off Monterey from the west.

The attack began on 20 September. Officers of both engineer corps participated, fighting side-by-side and working together on reconnaissance and planning assaults. Chief topographer Williams died in the fighting, and Mansfield was wounded. On the 24th, the Mexican commander offered to surrender if he could withdraw his army and obtain an 8-week truce. Taylor agreed. For their parts in the action, several engineers received brevet promotions.

This news from Mexico angered President Polk, and he ordered Taylor to resume operations. Meanwhile, Polk recognized it would take more than a few victories in the north to bring the Mexican government to the peace table. Adopting a new strategy, he shifted operations from northern Mexico and put General Scott in charge of a landing at Vera Cruz and a march to Mexico City. This decision assured that Taylor's army would soon be severely reduced in size and that the remaining units would become in essence an army of occupation on the defensive in northern Mexico.

Before that happened, Taylor fought one last battle at Buena Vista in February 1847. Joining him were forces under Brigadier General John E. Wool, who had advanced into Mexico from San Antonio. Wool brought with him a strong engineer component, including West Point graduates Captains Robert E. Lee and William D. Fraser. Captain George W. Hughes, one of the few non-West Pointers involved, was chief topographic engineer. On their way to join Taylor, Wool's army made the 164-mile march to the Rio Grande in just 11 days, using roads and bridges provided by the engineers. Unlike Taylor, Wool planned his Rio Grande crossing in advance. Led by Lee, the engineers assembled a 'flying bridge,' prefabricated in San Antonio, which carried Wool's men across in a single

day. From there, they proceeded in stages deeper into Mexico.

Hughes' report on the march detailed the difficult challenges and significant roles of engineers and topographers. The going was not easy. Hughes related: "We were almost literally compelled to grope our way and like a ship at sea to determine our positions by astronomical observations. Thus topographical parties usually had to be kept on the advance seeking camps and supplies of water, food, and fuel."

At Buena Vista, Taylor met a large Mexican army under General Santa Anna. In a complicated battle on 23 February 1847, the American forces formed a wide-angle "V" to turn the battle against the Mexicans. It was one of the most vicious engagements of the war. Once again, the engineers and topographers earned recognition and brevet promotions for their actions. As was their custom, the topographers prepared a detailed after-the-battle map of the action.

As the war in northern Mexico came to a close, peace was still more than a year away. The U.S. Army began to reflect on some sobering lessons of the campaign. Engineers had proven they could work together on the march and on the battlefield. Commanders had an opportunity to see firsthand the results of years of training at West Point.

The war with Mexico was the United States' only major war between 1815 and 1861. As such, it was a training ground for the Civil War.



Dr. Paul K. Walker is chief historian, Headquarters, U.S. Army Corps of Engineers, Alexandria, Virginia.

All quoted material is taken from the following sources:

Eisenhower, John S.D., *So Far From God: The U.S. War With Mexico, 1846-1848* (1989), Random House.

Traas, Adrian G., *From the Golden Gate to Mexico City: The U.S. Army Topographical Engineers in the Mexican War, 1846-1848*, U.S. Government Printing Office (1993).



ENGINEER UPDATE

Commercial numbers are (573) 563-xxxx and Defense System Network (DSN) numbers are 676-xxxx unless otherwise noted.

Department of Training and Doctrine Development (DOTD)

Engineer Unit Directory. Units are reminded to check their entries in the *Engineer Unit Directory* and send changes no later than 15 January 1997 to: Commandant, U.S. Army Engineer School, ATTN: ATSE-TD-D-P, Fort Leonard Wood, Missouri 65473. Changes also may be sent via e-mail: bakern@wood-vines.army.mil. The updated directory is scheduled for distribution in mid-March 1997. POC is Nancy Baker -4100.

Doctrine Product Updates. Several engineer-proponent doctrine products are accessible on the Engineer School Publications home page on the world wide web. The file location is: www.wood.army.mil/DDD/PUBS/pubs.htm. The following doctrine products are scheduled for distribution in printed media in the next few months:

Title	Initial Draft	Final
FM 5-428, <i>Concrete and Masonry</i>	Sep 96	
FM 5-116, <i>Engineer Operations Echelons Above Corps</i>	Nov 96	
EXFOR ST 5-105-1, <i>Digitized Topographic Operations</i>	Nov 96	
FM 5-105-1, <i>Topographic Operations</i>	Nov 96	
FM 5-499, <i>Hydraulic Power Control Systems</i>		Mar 97
FM 5-250, <i>Demolitions and Explosives</i>	Jan 97	
FM 20-32, <i>Mine Countermine Operations</i>	Jan 97	
FM 5-572, <i>Materials Testing</i>		Mar 97
FM 5-424, <i>Interior Wiring</i>		Mar 97
FM 5-34, <i>Engineer Field Data</i>	Feb 97	
EXFOR Special Texts Update (Bn, Co, Plt)		Nov 96
EXFOR ST 5-71-100-5, <i>Digitized Division Engineer Combat Operations</i>		Nov 96
FM 90-13-1, <i>Combined Arms Breaching</i>	Mar 97	
FM 90-13, <i>River-Crossing Operations</i>		Mar 97
FM 5-415, <i>Firefighting Operations</i>		Mar 97
FM 5-170, <i>Engineer Reconnaissance</i>	Apr 97	
FM 20-400, <i>Environmental Management</i>	May 97	

POC is Sandra Gibson, -4115.

NATO STANAGs. The Engineer School is working with NATO countries to revise STANAG 2036, *Land Mine Laying, Marking, Recording, and Reporting Procedures*, for which the school is custodian. FM 20-32, *Mine/Countermining Operations*, incorporates much of this STANAG. The Engineer School also is developing a proposal for a new STANAG that deals with countermining activities. Comments on STANAG 2036 or topics to be included in the new countermining STANAG are welcome. POC is CPT Joe Birchmeier, -4115.

Engineer Doctrine for Joint Operations. On 22 October, the Joint Doctrine Working Party approved a proposal to develop an overarching engineer doctrinal publication. The first draft is scheduled for review in summer 1997. (See article on page 26.) The Engineer School, the Army's representative on the working group, is developing the doctrine. We received a tremendous response to a recent request for information about joint engineer operations (such as tactics, techniques, and procedures; standing operating procedures; and operations plans) that will assist the development effort. If you haven't already done so, please forward material covering doctrinal "work arounds" your organization has developed. POC is MAJ Richard Graves, -4115.

Field Manual Inventory Reduction. The TRADOC Chief of Staff directed that all proponent schools reduce the number of field manuals in their inventory, and the number of pages in those manuals, by at least 20 percent. Each TRADOC school must prepare a plan to reach its established goal. The Engineer School is considering the following actions:

- Retain core manuals containing doctrine for units at brigade level and below.
- Consolidate like information in selected field manuals.
- Purchase commercial, "off-the-shelf" technical publications for low-density MOSs.
- Update engineer publications to support multiservice use.
- Place selected publications in "Inactive Publications Storage" until assets are available to permit updating.

A study addressing these options was provided to field commanders at the October 1996 Council of Colonels and the commanders' and directors' meetings. Units are encouraged to review the study and submit recommendations. POC is Lucius Warrick, -4115.

Directorate of Combat Developments (DCD)

Partnership Conference on Future Engineer Operations Concepts. Nearly 50 representatives from Army laboratories and research and development activities met at the Engineer School on 9-10 October for the Partnership Conference on Future Engineer Operations Concepts. Planned by the Futures Division of the Directorate of Combat Developments, its purpose was to show how attendees' organizations fit into the emerging Force XXI Army and the overall modernization equation. Additional meetings are planned to refine the process. The end result will be an Engineer Corps that is better able to support the total force. POC is Brian Murphy, -7214.

Engineer Personnel Proponency Office (EPPO)

Officer Development System Review. The Chief of Staff of the Army directed an Officer Personnel Management System task force to review the officer development system. The task force will review leader development, assignments, career management, character development, and the new Officer Efficiency Report. The Director of Training is the Engineer School's representative to the task force. This review provides an opportunity for you to express concerns and provide input into your future. For more information, visit the Engineer Personnel Proponency Office's home page at http://155.9.32.3/EPPO/eppo_hp.htm. The e-mail address is: zajacm@woodvines.army.mil. POC is CPT Matt Zajac, -4087.



BRIDGE THE GAP

By Command Sergeant Major Julius B. Nutter
U.S. Army Engineer School

The Centralized Promotion System

While traveling through Army installations, I often hear false myths and incorrect perceptions about the Army's centralized promotion system. To correct the many misconceptions, I will present the facts about the promotion system, which affects the career of every member of our Engineer Regiment.

A centralized system for the promotion of enlisted soldiers has been in effect since 1969. It became effective for the promotion of sergeants major on 1 January 1969, for master sergeants on 1 March 1969, and for sergeants first class on 1 June 1970.

The system is composed of several centralized enlisted promotion boards that have the following missions:

- Select candidates for promotion to sergeant first class, master sergeant, and sergeant major, and appoint command sergeants major.
- Select attendees for the resident Sergeant Major Course and the Advanced Noncommissioned Officer Course.
- Provide qualitative management program screening and an appeals process.
- Provide a qualitative management program final board.
- Provide standby advisory boards, as necessary.

The Secretary of the Army, through the Deputy Chief of Staff for Personnel, selects the individuals who sit on the boards. Each board includes both officers and noncommissioned officers (NCOs), and a general officer serves as board president. Nine to eleven panels comprise each board, with at least four members on each panel. The panels are organized by career management field (CMF), and the size varies in proportion to the number of records to be considered. Each panel has a nonvoting administration NCO, who controls the flow of records. A typical panel organization follows:

- Colonel (Engineer)
- Lieutenant colonel (Armor)
- Command sergeant major (CMF-19)
- Command sergeant major (CMF-12)

- Sergeant major (CMF-19)
- Sergeant major (CMF-51)

Training is an important first step for panel members to ensure that they vote consistently on each soldier's file. During this intensive training, they develop panel standards, practice voting on sample records, analyze practice votes, adjust standards, practice voting on additional sample records, make final adjustments to the standards, and obtain the board president's approval of the final standards.

During selection board proceedings, three board members review each soldier's individual record. They review the official military personnel file, microfiche, DA photo, DA Form 2A, DA Form 2-1 and other hard-copy documents, and compare them with the approved panel standards. Then they place a numerical score ranging from 6+ to 1- on each soldier's board file. This process ensures that no single success or failure is an overriding factor in determining the soldier's standing in relation to his/her peers. Panel members are charged to consider the "total soldier" in determining those best qualified for promotion.

The following chart shows the scoring system:

Score	Performance	Select
6+/6/6-	Excellent	Now
5+/5/5-	Excellent	Definitely
4+/4/4-	Strong	Should
3+/3/3-	Fully qualified	If room
2+/2/2-	Qualified in current grade	Retain in grade
1+/1/1-	Substandard	Quality Management Program referral

The Noncommissioned Officer Evaluation Report (NCOER) is the single most important document in determining the promotion potential of senior NCOs. It must be a clear and concise document that tells panel members how the soldier performed and where he can best serve the Army in the future. Despite its

importance, many NCOERs do not provide the information panel members need to adequately assess the performance and potential of the rated NCOs. There is nothing an NCO can do to compensate for a poor or mediocre NCOER.

Let me share a few observations about NCOERs reviewed by the FY96 master sergeant selection board.

Part III Duty Description

Part III (a) is extremely important. It tells the panel what job the NCO actually performed. The job description on some NCOERs did not match the soldier's principal duty title and/or the duty MOS. This reflected negatively on the soldier because the information did not provide a clear picture of what the soldier did on a day-to-day basis. It is especially important that the duty description of a soldier in a nontraditional or TDA position clearly state the specific duties and responsibilities of the position. That information enables panel members to make a reasonable decision as to the importance of the rated soldier's duties and the quality of his/her performance.

Part IV Values

In some NCOERs, the rated soldier received a "NO" block checked with a supporting bullet comment, but nothing was annotated on the back of the NCOER by the rater or the senior rater. The comments on the back

of the form must be specific and provide details that support the "NO" in the value block. They ensure that promotion board members get the intended message.

Part V Overall Performance and Potential

These two areas are most important when selecting the soldiers best qualified for promotion. Senior rater bullets are critical in determining promotion potential. The senior rater's comments should state clearly and concisely what he recommends Army leaders do with the rated NCO (promote ahead of peers, promote with peers, promote immediately, etc.). Senior raters also must ensure that the performance and potential blocks checked are consistent with the associated bullet comments. For example, a "Promote with peers" bullet and a "1" rating in the potential block are not consistent. The comments must focus on potential and help panel members make tough calls to clearly identify those soldiers who are superior to their peers. The statement, "The best platoon sergeant of five I currently rate" provides a definable standard that helps the panel make an informed decision.

The centralized promotion system is a creditable system. To keep it creditable, leaders must be involved in the NCOER process and educate their soldiers about the system. With sufficient leader involvement, the centralized promotion system will continue to meet the Army's needs.

(Continued from page 16)

The software also will display associated minefield records and query the database.

This subsystem includes a PC with CD-ROM reader, a JINC connected to the tactical SINCGARS UHF or an HF radio, a printer, and a Global Positioning System (GPS) card.

Digital Reconnaissance System

Reconnaissance teams use the DRS to collect minefield, obstacle, or other battlefield data. This information is digitally stored in a PC during the collection process. After collecting the data, reconnaissance units hand carry ("Sneaker Net" or floppy disk transfer) or use communications devices to transmit the results to higher headquarters.

This subsystem is identical to the

DMRS but also has a digital camera and laser binoculars. The camera allows the user to photograph the target and store the digital photograph with the report. Laser binoculars allow the user to capture accurate coordinates from a standoff of up to 1,500 meters. The PC captures the distance from the observer's location to the target object and the azimuth, directly from the binoculars, via a serial connection.

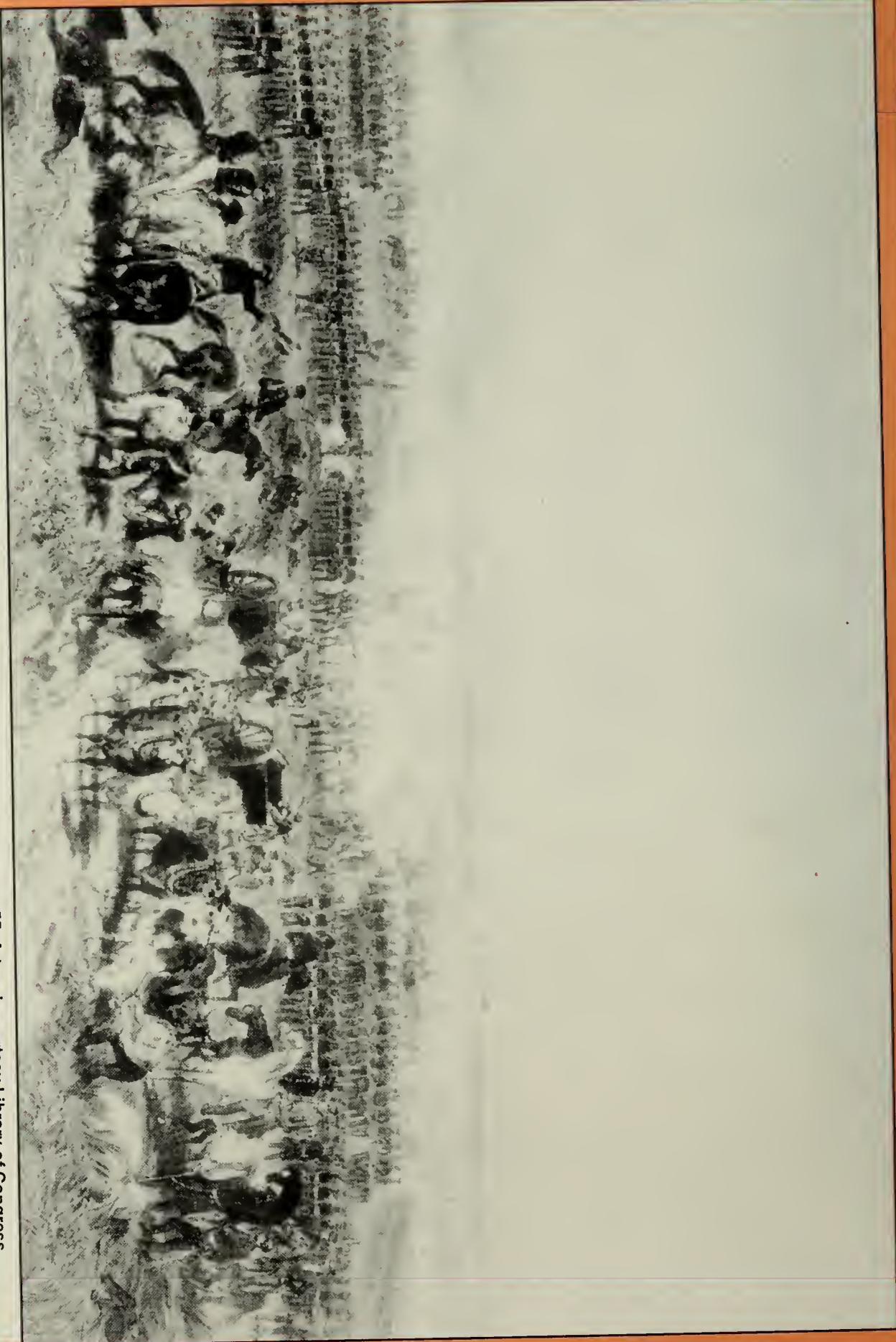
What's Next?

Parts of the interim system may go to Bosnia. Parts will play in the Task Force XXI exercise scheduled for March and April 1997. Most will be used in the JCM-ACTD in August 1997. Feedback from these events will shape the design characteristics of the objective minefield-database system.

By 2001, the objective system should seamlessly integrate with other Army Battle Command System (ABCS) programs operating at that time. Obstacle information managed by the system will integrate with other engineer command and control information and engineer intelligence throughout the ABCS. This system will ensure that commanders, planners, and soldiers have access to accurate and timely minefield information regardless of the theater or mission.



Major Taylor serves in the Directorate of Combat Developments, U.S. Army Engineer School. Previous assignments include tours with the 249th Engineer Combat Battalion (H), Germany, and the 52d Engineer Combat Battalion (H), Fort Carson, Colorado. He holds a master's degree from New Mexico State University.



Scene from the Battle of Palo Alto during the war with Mexico. For accompanying article, see page 55. Artwork courtesy Library of Congress.

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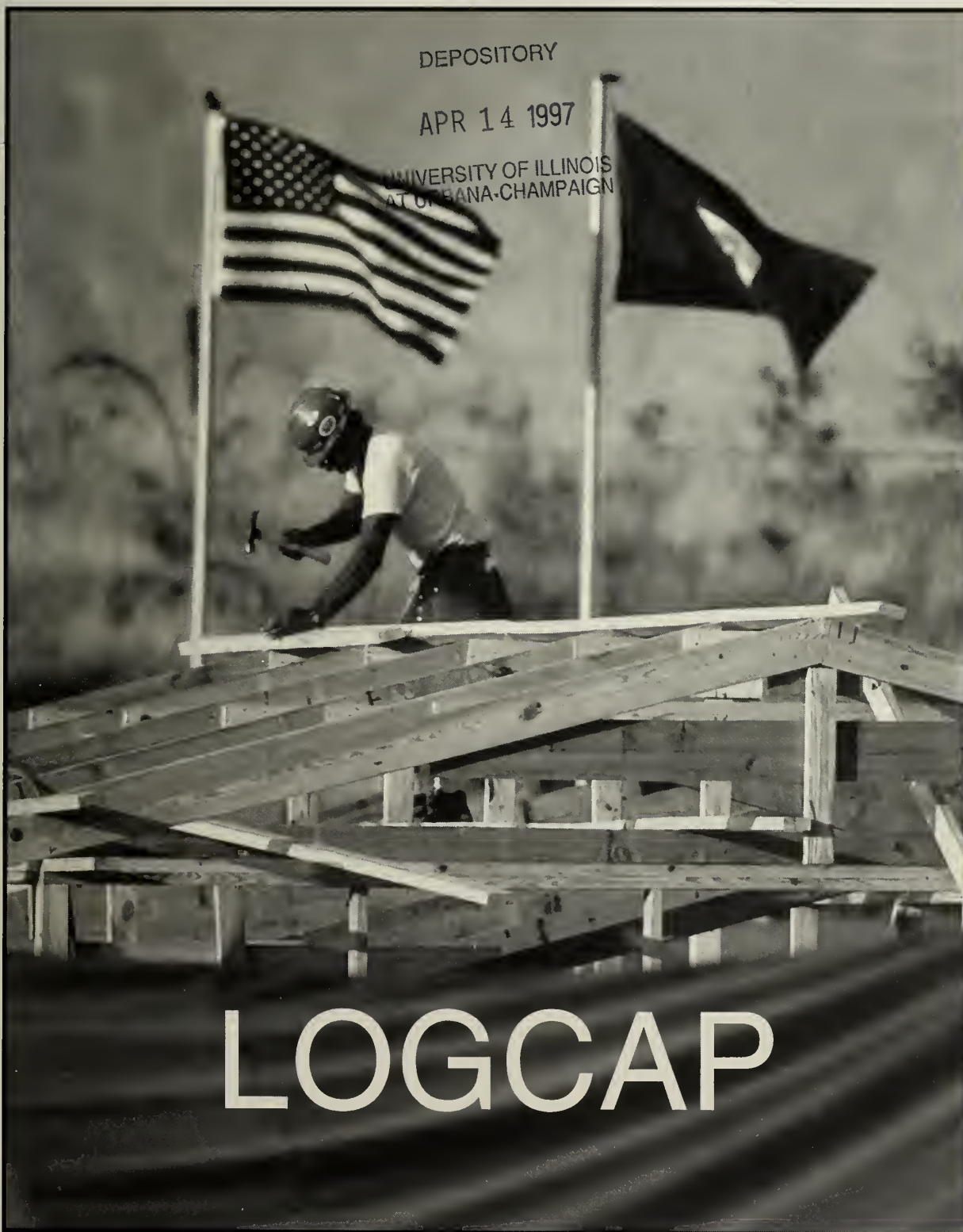
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LOGCAP

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CLEAR THE WAY

By Major General Clair F. Gill
Commandant, U.S. Army Engineer School

The topographer of the past wore buckskin and had a transit over his shoulder, a worn book of trigonometry tables and a sketch pad in his pouch, and a flintlock rifle in his hand. He opened the American wilderness with exploration and mapping. As the military terrain expert, he assimilated the terrain effects to advise commanders how to defeat the enemies of the 19th century. As we look to the future, the topographer will collect, develop, manage, analyze, and distribute digital data and products. His analyses and products will provide an accurate digital view of the battlefield and facilitate the assimilation of terrain effects to defeat enemies of the future. In both scenarios, topographers fulfill the same functions with different tools to accomplish the task at hand. They are the "terrain experts."

Information technology and digitization have revolutionized how the U.S. Army trains and fights. Nowhere is this more evident than in the field of terrain information and analysis. As the Army progresses toward Force XXI, there is a steady migration from paper maps and products to digital information and analyses. Digital data directly feeds battle command and fighting systems. With few exceptions, our new combat systems have embedded digital terrain requirements that far exceed the data available. Engineers must provide the needed digital data to the force. As Commandant, I have direct responsibility to ensure that we meet this challenge.

In the summer of 1996, I was charged by TRADOC to gain control over the development of terrain databases within the Army's modeling and simulations (M & S) community. The primary purpose of the study was to reduce duplication of efforts in the production of digital terrain databases and increase the accuracy of the data portrayed.

We quickly realized that the problem of defining terrain requirements, acquiring the data, and getting the information to the soldier extends beyond the M & S community. The quest for digitization and increased situational awareness make paper maps and associated terrain-analysis products less desirable. Furthermore, too many agencies are defining terrain data requirements and building unique databases. To remedy that situation, TRADOC established the Program Integration Office for Terrain Data (TPIO-TD) at Fort Leonard Wood. The TPIO-TD will function as a unifying agent in the digital terrain-data field.

The initial mission for the TPIO-TD was to "coordinate and synchronize all Army digital terrain data requirements for current operations (including distribution), combat developments, training, and models and simulation." That mission has expanded to include responsibility for the terrain analysis and evaluation functions that must be

embedded in the Army Battle Command System (ABCS).

To accomplish the expanded mission, the TPIO-TD developed four separate, though related, objectives:

- Establish the Army requirements document for all topographic data. Requirements include imagery, maps, digital terrain elevation data, and terrain feature data (roads, bridges, etc.) When the end-state requirements are established, the TPIO-TD will ensure that they are integrated with those of other services in a joint requirements document for the National Imagery and Mapping Agency (formerly the Defense Mapping Agency).
- Identify the critical capabilities that must reside within the various models, simulations, fire-control systems, and maneuver-control systems to facilitate the terrain-visualization process. These capabilities establish the requirements for the Common Terrain Operating Environment (CTOE). The CTOE will ensure interoperability within ABCS and the joint environment.
- Bring each individual system into compliance with the CTOE. This objective will become a continuing engineer mission to ensure that the acquired interoperability does not diminish over time.
- Define how digital topographic data distribution will occur within the combat force. The distribution concept also will define the process for database updates and enrichment.

These objectives will result in significant impacts for the engineer community across all DTLOMS (doctrine, training, leader development, organization, materiel, and soldiers) domains.

The first director of the TPIO-TD will be selected in FY 98 and should arrive at Fort Leonard Wood in the fall of 1997. I designated Colonel Ed Arnold, deputy director of the newly activated Maneuver Support Battle Lab, as the interim chief of the TPIO-TD. He is already working to complete the four objectives. Prior to formal funding approval by TRADOC, the Engineer School's Directorate of Combat Developments and USACE's Topographic Engineer Center at Fort Belvoir are providing much-needed manpower and technical support to jump-start the process.

Clearly, engineers are the masters of terrain. The requirement to provide accurate, useful digital terrain data will take on additional significance as we move toward the Information Age. I expect the TPIO-TD to map the path to Force XXI, although it is a formidable task with many obstacles. With engineers leading the way, I am confident that we will meet this challenge.

Engineer

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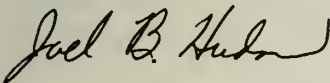
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Front Cover: The Army's LOGCAP contract provides engineering and logistics services for U.S. troops deployed to contingency operations. Here, a worker with Brown & Root Services Corporation constructs a facility during Operation Uphold Democracy in Haiti. Photo courtesy Brown & Root.

Back Cover: Many facets of the Fort Leonard Wood community are shown in this afghan design by Beverly Dunn of the Fort Leonard Wood Officers, Civilians, & Women's Club.

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LOGCAP: Providing Vital Services to Soldiers

By Lieutenant Colonel Nicholas J. Kolar, Jr.

Contracting for supplies and services by the U.S. military during times of crisis is not new. The practice has a long history dating back to the American Revolutionary War. The military's use of civilian contractors in theaters of war has steadily expanded during all subsequent conflicts. Operations in support of the Vietnam War particularly highlighted the need for civilian contractor capabilities to augment combat support and combat service support forces. However, it wasn't until nearly a decade after Vietnam that the concept for preplanning for civilian contractor support in a wartime theater began to take shape. In 1985, the Army formalized the concept as the Logistics Civil Augmentation Program (LOGCAP) under the proponenty of the Deputy Chief of Staff for Logistics (DCSLOG).

History

Initially, Army major commands (MACOMs) individually identified and contracted for their supply and service requirements. In 1988, the U.S. Army Corps of Engineers (USACE) became directly involved when Third U.S. Army (the Army component of the U.S. Central Command) requested assistance in contracting for a management plan to construct and maintain two petroleum pipelines in Southwest Asia to support contingency operations. The Corps was also preparing similar contracts for dredging and obstacle

removal, stevedoring, transportation, and mortuary services.

These early independent activities provided the genesis of the current program. In 1992, LOGCAP was restructured to incorporate a single, worldwide services contract to preplan for theater facilities and logistics support services during war and contingency operations. Because of previous LOGCAP expertise, the DCSLOG designated the USACE Transatlantic Division (now the Transatlantic Programs Center) as contract administrator.

In August 1992, a one-year contract with four one-year renewal options was competitively awarded to a major worldwide civilian contractor, the Houston-based Brown & Root Services Corporation. The contract value at award was \$3.9 million. At that time, it was not envisioned that LOGCAP would ultimately become such an integral part of our force projection strategy. No one (including the contractor) would have guessed that the contract would soar to its current level of more than \$750 million.

The guiding principle of LOGCAP is to preplan for the use of global corporate resources as an alternative in support of contingency operations and to augment combat support and combat service support force structures when identified shortfalls exist. LOGCAP's fundamental goals are to—

- Plan during peacetime for the effective integration of contractor support during times of crisis.

- Leverage existing global and regional corporate resources as facility and logistics support multipliers.
- Provide a quick-reaction capability to contingency or crisis requirements.
- Provide an alternative capability to meet facility and logistics services requirements.

The contractor plans support in five broad categories:

- Facilities
- Supplies
- Services
- Maintenance
- Transportation

This seemingly simple scope of work for planning—to provide basic life-support and logistics services to our soldiers—has proven to be complex in execution. At the heart of the complexity are two critical elements: where the services are to be performed (often in harsh, desolate environments with little usable infrastructure) and the speed at which the services must be provided (normally concurrent with the first wave of troop deployment).

During the last five years, LOGCAP has supported six contingency operations, referred to as events, and no two were the same. From the contract's first contingency activation in December 1992 for Operation Restore Hope in Somalia through its current effort to provide a full range of

engineering and logistics services in support of Operation Joint Endeavor in the Balkans, the contractor and the Corps have successfully met the Army's needs despite numerous difficulties.

The Contract

The expectation of uncertainty was the driving factor in selecting the type of contract used for LOGCAP. Each contingency operation is created from a different set of conditions. Because it is impossible to write a firm, detailed scope of work that will support the full spectrum of potential military involvement, the Corps settled on a contracting mechanism that allows maximum flexibility for accomplishing any Army mission.

A cost-reimbursement contract is used, with a base and award fee structure that determines the amount of profit the contractor should receive. This type of contract is commonly called *Cost-Plus Award Fee*. Under the LOGCAP contract, a scope of work and an estimated cost of performing the work are negotiated for each event. The contractor is reimbursed for all costs that are reasonable, allowable, and allocable under the contract terms. The contractor is assured of a one percent base fee in both planning and event execution. The award fee plan centers around three focus areas: performance; cost control; and coordination, flexibility, and responsiveness. The contractor can earn an award fee up to five percent of the contract amount for planning and up to nine percent for event



Photo by Tommie Vest

Modular units were provided as housing in the roughest terrains in Bosnia, as shown here at Camp Linda.

execution, depending on the accomplishments in each focus area. The percentage of award fee is based on the estimated cost for both planning and the event. The contractor does not earn an additional fee if the actual cost of performance exceeds the estimated cost.

Concept of Operations

An initial planning requirement was for Brown & Root to develop a worldwide plan and 13 country-specific plans that were designated and prioritized by the supported MACOMs. The contractor also was required to develop and maintain a worldwide database of available supplies and services. A follow-on requirement reflected the Army's difficulty in predicting the location of contingencies; it broadened the planning from 13 specific countries to 13 regions. All planning efforts are coordinated with the Corps and the appropriate MACOM. Under the operational concept, the contractor has a country or regional plan prepared when it is activated to support a contingency event. Brown & Root is required to respond quickly, relying on their corporate worldwide presence and pre-established contacts to provide immediate services.

Under the generic contingency scenario used in the initial contract, Brown & Root is required to set up sea and aerial ports of debarkation for deployed personnel. Soldiers are transported to a rear-area support base before being further deployed to forward-area base camps. In this scenario, the contractor is required to begin receiving 1,300 soldiers per day with less than three weeks of notification and is responsible for providing a full range of facilities and life-support services. This scenario calls for support to 20,000 troops, with possible increases to 50,000. The contractor is also required to maintain the capability of supporting two events concurrently.

A salient contract condition is that contractor personnel are provided security by the deployed U.S. forces. While this appears to be a simple provision, it has proven difficult to execute, especially at the beginning and end of events. Therefore, the operational commander now has an additional security requirement to consider in his planning. Since services are required up to the last soldier's departure, close coordination between units and the contractor is required.

Security also parallels a provision that directs the contractor to assume that all work to be accomplished during an event will take place in a hostile environment. This assumption has often become a reality:

- In Somalia, banditry and warlord hostilities were pervasive. Despite the contractor's best efforts, a contractor employee was injured by small-arms fire.
- In Haiti, impoverished conditions created their own dangers. Something as simple as transporting trash to the dump became dangerous when hoards of poor Haitians tried to climb on or stop the trucks to seize the "treasures" on board.
- In Bosnia, the proliferation of mines and a tenuous peace have created a unique set of force protection and security concerns. It is a credit to the security provided by the

U.S. commanders and the contractor's excellent security judgment that no contractor personnel have died due to hostile activity.

Events over the past five years have confirmed that contingency planning can never be an exact science. The generic operational concept in the original contract was generally used, but rarely did all the pieces fit precisely. Because of this, contractual and contractor flexibility are critical to the program's success, as the following examples show:

- The program was envisioned to support the Army but is available to other service components (the Navy and Air Force). It is also used by the United Nations to support multinational peacekeeping forces.
- No country plan was developed for Operation Restore Hope in Somalia. This operation required an expedited planning and deployment process.
- In some contingencies, such as those in Zaire (Operation Support Hope) and Southwest Asia (Operation Vigilant Warrior), LOGCAP provided only minimal levels of logistics support to the military operations. In other cases, such as Bosnia, LOGCAP was a primary logistics service supplier.
- Some events were supported concurrently (Operations Uphold Democracy in Haiti and Vigilant Warrior). During this same time period, the contractor also was called on to retrograde military equipment left in Somalia for U.N. use under Operation Restore Hope.
- During Operation Deny Flight in Italy, LOGCAP provided only facilities support.

LOGCAP was sometimes used (as in Haiti and Somalia) to supplement logistics support provided to U.S. forces deployed under United Nations peacekeeping missions following the conclusion of U.S. operations. Under these conditions, the U.N. contract provisions were below the quality-of-life standards for our deployed forces. For example, the U.N. food services contract only provides a basic ration of meat, vegetables, and rice or other starch per person on the deployed team. Individual country support organizations must budget for cooking the rations and additional items (such as dairy products, desserts, and special meal provisions).

What did these differences in execution mean to the Transatlantic Programs Center as contract administrator? The keys to success were flexibility and good staff coordination. Our contracting officers and primary staff were familiar with the contract terms and often were the first to educate the customer about the appropriate use of the contract. Each event required extensive coordination with the Army DCS-LOG staff, the MACOM staffs, host-nation officials, the Corps team in theater, and the Defense Contract Management District/International (DCMDI).

A memorandum of understanding between DCMDI and the Transatlantic Programs Center provides field contract administrative services for other than facility construction support during the execution of LOGCAP events. In this

capacity, DCMDI provides administrative contracting officers, cost and price analysts, quality assurance representatives, and industrial property management specialists to ensure proper oversight of the contractor and protect the government's interests. During operations where no logistics services were involved (Operation Deny Flight), support from DCMDI was not necessary.

In addition to project management and contract administration coordination, managing LOGCAP requires significant legal review and financial management services.

Operation Joint Endeavor

Supporting operations in the Balkans for Operation Joint Endeavor would have required a much more robust combat support and combat service support military organization had it not been for the use of LOGCAP. From the very start of this operation, LOGCAP has provided most of the critical logistics and engineering services, with costs exceeding \$460 million for the first year's effort. Use of LOGCAP allowed the deployed combat units to focus on critical operational missions and the deployed engineering units to focus on horizontal construction.

On 26 November 1995, Brown & Root was activated to provide an intermediate staging base at Kaposvar and Taszar, Hungary. There was no opportunity for a reconnaissance or advance facilities placement or services. On 1 December, the contractor entered the theater concurrent with the military units. Although mobilized in Kaposvar, the contractor was unable to begin operations and award subcontracts until 5 December, when negotiations between the U.S. Army and the Hungarian government were concluded. The initial work focused on renovating old communist barracks to bring them to minimum standards for use by U.S. soldiers. Then, working with the soldiers, the contractor's staff braved the same harsh weather and site conditions to provide warm tents, hot food, and adequate sanitary facilities during the start-up of operations throughout the theater.

After establishing the intermediate staging base, the contractor was tasked to support the 1st Armored Division's Task Force Eagle by setting up and operating camps in Croatia and Bosnia. The original deployment plan envisioned one camp in Croatia and 12 camps in Bosnia. During execution, the number of camps in Bosnia grew to 24 main camps and several smaller locations, because the rough terrain did not accommodate large camps. These life-support areas were set up in abandoned factories and war-damaged buildings; on parking lots, farmlands, and fields; and in U.N. camps taken over by the United States. All sites required significant upgrades.

In order to complete all the Bosnia camps by March 1996, Brown & Root was integrated with other Army engineer units, Navy Seabees, and Air Force Red Horse engineers on a fast-tracked scenario. Specifically, Brown & Root's tasks were to—

- Set up 12 camps.

- Provide flooring materials for the Army, Navy, and Air Force engineer units charged with setting up all other camps.
- Upgrade all camps to meet the Army's sustaining base standards by replacing soft-side, canvas tents with hard-back tents or modular buildings (in areas with the harshest conditions).
- Provide all basic life-support services, such as food services, laundry, water delivery, garbage collection, and shower and sanitary facilities.
- Provide other logistics services, such as transportation and cargo handling, vehicle maintenance and washing, port operations, road repair and maintenance, and storage yards.

The work was executed under the supervision of a Corps team led by the Transatlantic Programs Center, Europe, headquartered in Wiesbaden, Germany. The center established a cell to support the forward element of the U.S. Army Europe's Deputy Chief of Staff for Engineering. Besides LOGCAP support, the Corps cell provided engineering and environmental services and real estate assistance to lease areas used for base camps and to support other military operations. Additionally, the center helped coordinate the activities of other USACE elements supporting operations in the Balkans.

The force deployed for Task Force Eagle was the largest combat force deployed outside a war zone since World War II. To facilitate the development and sustainment of the array of bases required in Bosnia, a new organization named the Base Camp Coordination Agency (BCCA) was created. This organization is still operating and is a nondoc-trinal hybrid Directorate of Public Works and USACE resident office organization. The speed at which the BCCA was formed and its composition truly reflect the engineers' motto—"One Corps, One Regiment, One Fight." (*An article describing the BCCA will be published in the April issue of Engineer.*)

In December 1996, the peacekeeping mission transferred from the 1st Armored Division to the 1st Infantry Division, and the name of the operation changed to Joint Guard. The Corps presence ensured a seamless transfer of responsibility and training of new leaders on camp operations. While initially intended to last only a year (until 26 November 1996), LOGCAP-type services are now expected to continue for an additional 18 months.

At the peak of Operation Joint Endeavor, the Corps had 60 military and civilian personnel operating in the Balkans; Brown & Root had approximately 6,000 workers, most of whom were hired locally.

As the Corps and the Army staffs have worked together on LOGCAP operations, they have identified the following program strengths:

- Provides responsive contractor support during early deployment.



Temporary facilities were built in Haiti to support Operation Uphold Democracy. These buildings typically housed dining areas, showers, latrines, and recreational areas such as libraries.

- Exploits civilian resources, supplies, and transportation, and does not compete with strategic lift.
- Improves peacetime planning for contingency operations.
- Ensures contract and government team continuity because of greater exposure during planning, military exercises, and contingency operations.
- Frees military manpower for use in combat and other critical tasks.
- Satisfies early entry, sustainment, and redeployment requirements. The program's flexibility allows for the rapid addition or deletion of logistics requirements.
- Costs less than if the military had performed the tasks without LOGCAP assistance, according to a report prepared by the Logistics Management Institute.
- Incremental funding of an operation where costs and duration are known poses administrative problems that could be avoided for the contracting entity.
- Quality-of-life standards are changing. For a lengthy peacekeeping deployment, such as Operation Joint Endeavor, commanders want their soldiers to have an acceptable living standard that includes good food, a warm place to sleep, and some forms of recreation.

Looking Ahead

As LOGCAP evolved over the past five years, logistics services dominated the military's needs under the contract. In April 1996, the Army designated that the logistics umbrella contract should be under a logistics command, the U.S. Army Materiel Command (USAMC). USAMC assumed program management responsibilities on 1 October 1996, although the Corps retains responsibility for the existing contract through August 1997 and for close-out activities of the current contract. The two organizations developed a memorandum of agreement for the transition period to ensure that essential LOGCAP services are provided during planning and contingency operations. USAMC awarded a new contract on 30 January 1997.

After five years of managing this contract on behalf of the Department of the Army, the Corps of Engineers is proud to have participated in this important program. It has provided critical services to our deployed service members.

Lessons Learned

Each LOGCAP event has produced a unique set of lessons learned. But each event had the same synchronization challenges: defining the contract's scope of work (in conjunction with the user) and funding the work.

The following lessons can be applied toward making LOGCAP more effective in meeting the needs of our forces during contingency scenarios:

- Train the leaders who will use LOGCAP services. They must clearly understand what services can be provided and the mechanisms for getting them, including the cost.
- The contractor is a member of the deploying force and should be treated accordingly. His senior managers must deploy early. He must attend the commander's meetings with the government's contracting officer.
- The government must better identify government-furnished equipment and materials that will be available for the contractor's use.

Lieutenant Colonel Kolar is deputy commander, Transatlantic Programs Center, Winchester, Virginia, where he oversees administration of LOGCAP. He previously served as facilities plans officer, Facilities Engineering Division, Logistics/Security Assistance Directorate, for the Commander in Chief, U.S. Pacific Command. LTC Kolar is a graduate of the U.S. Military Academy at West Point and has three master's degrees. He has been awarded the deFleury medal from the Society of American Military Engineers.

Engineers Support the United Nations in Macedonia

By Major Richard Hook and Patrick Siska

Since July 1993, the United Nations has conducted peacekeeping operations in the Former Yugoslav Republic of Macedonia (FYROM). A 500-soldier U.S. battalion supports the mission from Camp Able Sentry and 12 outlying observation posts along the northern and north-eastern borders of Macedonia and Serbia. A Nordic battalion shares the U.N. mission within its sector west and southwest of the U.S. battalion (see figure, page 8).

U.N. Mission

The "Macedonian Command" operation was originally called the United Nations Protection Force (UNPROFOR). In March 1995, the operation was changed by U.N. resolutions and renamed United Nations Preventive Deployment (UNPREDEP). Their peacekeeping mission is to—

- Maintain a U.N. presence at borders with Albania and the Federal Republic of Yugoslavia (Serbia and Montenegro) to monitor border areas.
- Strengthen mutual understanding and dialogue among its political, social, and ethnic forces and groups.
- Assist in advancing social progress and development.
- Promote multicultural and multiethnic cooperation.

U.S. Mission

Eight U.S. infantry, cavalry, and armor units have served six-month tours in Macedonia as Task Force Able Sentry. Their mission is to conduct peacekeeping operations in support of the UNPREDEP Force. The U.S. battalion currently there is the 1-63rd Armor, 3rd Brigade, 1st Infantry Division. The supporting engineer platoon (1st Platoon, B Company, 46th Engineer Battalion) provides carpentry, earthmoving, electrical, mechanical, and plumbing support at the base camp and observation posts (OPs).

Task Force Able Sentry accomplishes its mission with four companies that rotate from the base camp to the OPs every three weeks. In the western sector, B and D companies

control five border OPs and one company OP. In the eastern sector, A and C companies also control five border OPs and one company OP (see figure, page 8). While in sector, the companies maintain the OPs with ten soldiers. Patrols monitor the situation along the border 24 hours daily—on foot or by vehicle or helicopter.

During the task force's mission in sector, engineers at the base camp receive work orders from the company OPs to make repairs at the border OPs. 1st Platoon deploys a "quick-fix team," which stays at the site until repairs are completed—usually one to three days, depending on the difficulty of the work and the weather. Additionally, 1st Platoon's heavy equipment squad repairs the vehicle fighting positions and maintains the roads in sector.

While two of the four companies maintain the OPs in the task force sector, the third company remains at the base camp as the Force Protection Company. The fourth company provides the Quick Reaction Force (the security element) and rotates its tank crews through the Mobile Conduct-of-Fire Trainer (MCOFT). This equipment allows the tank crews from the 1-63rd Armor to maintain basic tank gunnery skills.

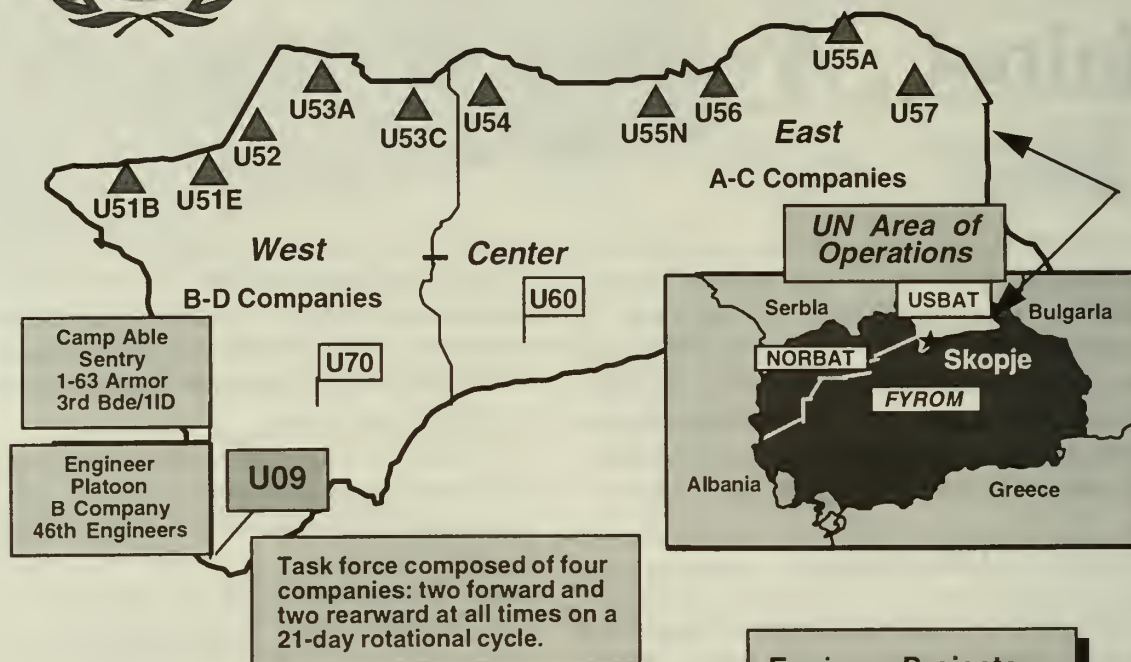
The task force engineer, the platoon leader, and the platoon sergeant operate from the base camp. The task force engineer works with the commander and executive officer to prioritize, budget, and coordinate projects. In addition to managing the platoon, the platoon leader and platoon sergeant share the task force engineer's workload. They also brief high-level civilian and military dignitaries who visit the area. Some of the projects engineers manage at Camp Able Sentry and the OPs are shown on page 8.

Engineer Support

Although the United Nations approves its mandate to Macedonia every six months, the engineer assets available to engineers supporting Task Force Able Sentry are limited (see figure, page 8). The original allocation of 15 engineers per rotation in 1993 gradually increased to 32 by 1996. But the continual, daily "breakdown maintenance" program was beyond the capabilities of the engineer platoon.



Task Force Able Sentry Engineer Operations



USAREUR/ODCSENG Base Camp Projects

- 7 Observation post road upgrades
- Electrical upgrade
- Heating/water upgrade
- Plumbing/sewer upgrade

Engineer Projects

- U54 Retaining wall
- Guard tower
- Road maintenance
- Facilities maintenance
- Snow removal

Engineer Force Protection Work

- Protective barrier
- Concertina
- Additional tower
- Perimeter lighting
- Perimeter clearing

Equipment/Personnel

Heavy Equipment Squad
 2 M920 trailers
 2 Dozers
 2 SEEs
 1 Bucket loader
 2 Graders
 4 HMMWVs

Vertical Squad
 8 Carpenters
 1 Plumber
 1 Electrician

Quick-Fix Team
 8 Carpenters
 1 Plumber
 1 Electrician

Legend:

- ▲ Border Observation Post (10 personnel)
- Company Observation Post (20 personnel)
- Base Camp Able Sentry (360 personnel)

USBAT - U.S. battalion

NORBAT - Nordic battalion

The Office of the Deputy Chief of Staff for Engineers (ODCSENG) and the 1st Infantry Division completed several studies to determine how to improve base camp facilities and upgrade roads leading to the OPs. Because of significant resource constraints, the UNPREDEP Engineer Services Section could not help upgrade Camp Able Sentry. In April 1996, as part of a major initiative to improve a quickly deteriorating situation, the U.S. Army Europe (USAREUR) commander approved the allocation of \$3.2 million to improve the base camp and seven OP roads. Since the task force staff could not manage all of these projects, both the Facility Engineer Division and the Military Engineering and Topography Office of ODCSENG, HQ, USAREUR, supervised project management. Started in July 1996, the road upgrades were completed in November. The first phase of base camp improvements was finished in December; the second phase should be completed by the end of March 1997.

As with all engineer operations and projects, numerous lessons were learned that can benefit many in the Corps of Engineers. The following lessons are provided to assist engineers on future deployments to Task Force Able Sentry or similar U.N. operations.

Echelons Above Corps Lessons Learned (ODCSENG, HQ, USAREUR)

Coordination With Local Contractors

Discussion: Most host nations welcome U.N. operations. Developing countries are very hospitable and want to establish a strong market economy with close western ties. Their desire to be friendly and avoid problems may challenge the interpersonal skills of any engineer. Meetings with local contractors must occur at least once a week and on the same day of each week. The goals of the meetings must be outlined prior to the meeting. After the meeting, providing the contractor with a summary of what was agreed (or disagreed) upon will help if issues resurface two or three months later. Workers in Macedonia are not well paid, so it is not in their best interest to complete a project on time. The daily work hours are short (0900 to 1500 hours) and the workers' productivity is low. The contracting officer's representative must always be visible so the contractor can ask questions and workers can see that someone is pushing the project to completion.

Recommendation: Develop a comprehensive contractor assessment plan for the duration of the contract. Consider incentives such as award-type contracts so contractors will provide quality and timely performance.

Coordination With the Host Nation Ministry of Defense

Discussion: The civilian engineer staff found that having a "green suiter" present when coordinating with the Mace-

donian Ministry of Defense helped develop a successful working relationship. For example, on a water line project outside of the base camp, the Ministry of Defense wanted to control the project, so they awarded the contract. When the contractor had financial problems, another company was contracted to furnish pipeline materials. This was a difficult project to manage and often required that UNPREDEP military leaders apply appropriate political pressure to resolve problems and keep the project moving.

Recommendation: Deploying units should coordinate closely with civil affairs units or military liaison teams in the host country. These elements can provide accurate information on departments or personnel to support the planning process. They can also assist with complicated political contractual agreements.

Project Scheduling and Quality Control/Assessment

Discussion: In many parts of the world, the democratic process is still in its infancy. The work ethic in these countries differs significantly from what we expect from contractors in the U.S. or NATO countries. Engineers must be realistic in developing project time lines. Extended research on how contractors in the host nation work will save a lot of headaches. For example, examine projects a contractor has completed or review recommendations from other sources when selecting a contractor. The project manager must set goals based on known capabilities of the host nation's managers and workers. Finally, question the contractor on other projects that it is conducting. You may find that trucks bringing gravel to your roads actually belong at another project site!

Recommendation: The project manager must quickly learn the capabilities of potential contractors. Identify companies with potential money problems or corruption due to many layers of "management." Question contractors in detail about their quality-control measures.

Project Status Reports

Discussion: Develop status reports for ongoing projects. The reporting officer must ensure that coordination occurs with budget, intelligence, logistics, and operations staffs to avoid confusion over ongoing or completed actions. Most headquarters will want reports two or three times a week. Continuous coordination with all staffs on the reporting format ensures that the project manager does not allow a reported problem to get out of control. Checking with the various staffs on incoming and outgoing personnel helps ensure that new personnel understand the reports.

Recommendation: When developing project reports, ensure that all staff agencies agree with the format. Have them provide telephone, fax, and e-mail numbers/addresses. Resolve any misunderstandings on reported items.



A Baumholder DEH employee teaches engineers from B Company, 46th Engineer Battalion, how to operate and maintain a snowplow.

Snowplow Training for Winter Operations

Discussion: After spending \$2.4 million on seven observation post roads, the ODCSENG staff realized the need for classes on snowplow equipment operation and maintenance so that the roads would not be destroyed during one winter. The staff coordinated with the Directorate of Logistics, in Baumholder, and the Cold Regions Research Engineer Laboratory (CRREL) for classes. Conducted in October 1996, the training helped engineer soldiers understand the operational and maintenance requirements of the four German-made Schmidt plows assigned to the task force. The CRREL representative also provided an assessment of additional snowplow equipment the unit needed.

Recommendation: Before deploying to an area with a potential for winter operations, request soldier and unit training packages from CRREL. The laboratory staff is very responsive to requests for training materials.

Unit-Level Lessons Learned (1st Platoon, B Company, 46th Engineer Battalion)

Predeployment Training and Turnover of Engineer Responsibilities

Discussion: Engineers supporting Task Force Able Sentry faced two challenges: deploying from the continental United States and conducting home station training compatible with the USAREUR designated training tasks to validate the unit entering the theater. The previous engineer unit (A/94th Engineer Battalion) rotated two platoons through two rotations at Task Force Able Sentry and was familiar with the USAREUR predeployment training and validation requirements. Task force personnel sent a training package to B/46th Engineers, who completed the tasks at Fort Rucker, Alabama. Once in Macedonia, a sergeant from A/94th Engi-

neers spent a week with the task force engineer, the platoon leader, and the platoon sergeant from B/46th Engineers to explain the engineer missions and the status of projects. The most important aspect of the turnover was that the early coordination between the two units allowed B Company to quickly take over the Task Force Able Sentry engineer mission. Later, the task force engineer and the platoon leader developed a training plan for the follow-on engineer unit, which deployed to Macedonia in March 1997.

Recommendation: Units deployed to support any U.N. operation should develop a "smart book" or "scrapbook" of coordinated actions, points of contact, and other information that may help follow-on units as they assume the same duties. Develop detailed checklists on work orders and project management to assist engineer leaders in briefing their follow-on counterparts.

Engineer Equipment Under U.N. Control

Discussion: Another important aspect of early coordination between the outgoing and incoming engineer units is understanding the types and quantities of equipment on hand. Units must bring a robust prescribed load list (PLL) to support the U.N. engineer equipment already there. The figure on page 8 shows the engineer equipment allocated for Task Force Able Sentry.

Recommendation: Before deployment, request a PLL from the current engineer unit, with suggestions on items that might be most critical during the rotation. The logistics assistance officer can notify units if certain parts must be purchased locally or special ordered from the United States.

Engineer Personnel

Discussion: The task force cannot change the allocation of engineer personnel above the 32 currently designated. The two most important skills required for supporting Task Force



The Facilities Engineer Division staff checks the concrete work on the Camp Able Sentry water tank.

Able Sentry are those of the electricians and plumbers. The engineer equipment mechanic has the next most critical skill. The two mechanics allocated to the previous task forces could not keep up with the intense repair requirements of the low-density engineer equipment.

Recommendation: Engineers deploying on engineer missions must assess the types of horizontal and vertical tasks required in the area of operations. Engineer equipment is used often and takes a beating on job sites. Engineer platoons deploying to Macedonia need three mechanics.

Repairing Electrical/Mechanical Equipment

Discussion: Engineers must often repair electrical and mechanical equipment that is critical for the task force to sustain operations. For example, engineers in Macedonia repaired water, sump, and condensation pumps; dining facility equipment; and components for heating and water systems. Many of these repairs were on equipment that is considered outdated in the United States.

Recommendation: Engineers should receive more training on electrical and mechanical components and systems during Noncommissioned Officer Education System (NCOES) courses. Additionally, units deploying to countries with older engineer equipment and systems should work with the Civil Affairs personnel to identify local firms with knowledge of that particular equipment or machinery.

Establishing a Base Operations Contract

Discussion: The greatest management challenge for engineers supporting a task force in Macedonia is balancing the work orders for the 12 outlying OPs with the facility maintenance requirements of Camp Able Sentry. The task force commander's priority is to maintain the carpentry, electrical,

plumbing, and water requirements at all of the OPs. Unfortunately, things continue to break on the four buildings that serve as headquarters and living quarters at the base camp as well. The task force engineer, platoon leader, and platoon sergeant must find supplies on the local economy to repair items at the OPs and the base camp.

Recommendation: Engineers deploying to fixed sites, such as Camp Able Sentry, need the capability to organize a base operations contract. This capability would allow the task force engineer to contract locally for a building maintenance contractor who would report daily for emergency and routine electrical, plumbing, sewer, and water repairs. Such a contract would allow task force engineers to focus more attention on repairs at outlying OPs.

Conclusion

As with all engineer operations, the lists of lessons learned from Macedonia are long and varied. This article provides some of the most beneficial lessons to assist engineers on future deployments to Task Force Able Sentry or to similar U.N. operations. Many civilian and military members of the U.S. Corps of Engineers contributed to the success of the Task Force Able Sentry deployments. To them, we say "Essayons!"



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Environmental Actions in the Former Republic of Yugoslavia

By Major Charles Litzelman

As U.S. forces deployed with the Implementation Force (IFOR) in support of the Dayton Peace Accords, it became apparent that the Army's environmental program would encounter a monumental task. The high degree of urgency and command emphasis on force protection and basic quality-of-life issues would force environmental initiatives, which had been successfully integrated into the culture of the armed services during the past 10 years, to take a back seat. This could adversely affect the soldiers' health and eventually have financial consequences if a strong program wasn't implemented and enforced.

The goal of the environmental program for the area impacted by Operation Joint Endeavor was straightforward and synchronized with guidelines in Army Regulation 200-1, *Environmental Protection and Enhancement*: "To plan, initiate, and carry out all actions and programs to avoid or minimize adverse environmental impacts without impairing the Army's mission."

Background

One of the greatest challenges in ensuring an environmentally sound program was the extensive area of operations.

Technically, U.S. operations during Joint Endeavor fell under the 7th Corps, U.S. Army Europe (USAREUR), major command (MACOM). The theater of operations included Hungary (the intermediate staging base [ISB]), Croatia, and Bosnia—with each country having separate and diverse environmental regulations, policies, and problems. The operation included 20,000+ troops (division [+]) and covered more than 28 base camps, forward operating sites, and major staging areas.

For NATO countries, U.S. policy centers on the Overseas Environmental Baseline Guidance with specific standards developed for the final governing standards. Since comprehensive environmental standards were not defined during this deployment, forces in the ISB focused on the stringent standards practiced in Germany. Policy for points further south (Croatia and Bosnia) were more relaxed, since no existing regulations governed non-NATO countries or countries new to the international community. In addition to enforcing environmental standards, the Army must comply with force-protection requirements. Since Croatia and Bosnia were classified as hostile areas, less stringent environmental standards were applied than would have during peacetime. The task of the environmental

program was to ensure compliance with these standards, clean up spills, and if necessary, remediate contaminated sites.

By December 1996, U.S. forces had generated the following waste materials:

- 2,709 drums (55-gallon) of mixed petroleum, oils, and lubricants (POLs)
- 334 drums (55-gallon) of antifreeze
- 96 drums (55-gallon) of nonhalogen solvents
- 738 drums (55-gallon) plus 180 cubic yards of contaminated soil
- 30 kegs (15-gallon) plus 37 containers (5-gallon) of battery acid
- 575 empty metal containers (55-gallon)
- 18,946 empty metal containers (5-gallon)
- 795 empty metal containers (1-gallon)
- 79 drums (55-gallon) plus 1,690 bulk gallons of wastewater and fuels
- 20 asbestos brake pads
- 7,475 lead acid batteries

Disposal methods ranged from recycling to trucking wastes to approved disposal sites in Germany or Bosnia. The Tuzla City (Bosnia) power plant burned mixed POL wastes, while some contaminated wastes (antifreeze, lithium batteries, and oil filters) and contaminated soil were disposed of in-country when conditions permitted.

More than 25 spills, ranging from 25 to 9,000 gallons, contaminated the soil. The average spill was 200 gallons. The most common cause was traffic accidents, some involving fuel tankers. The largest spill occurred at the Lukavac fuel bladder farm when a liner was installed improperly. Remediation of that spill consisted of two phases: extraction of fuel that collected three feet below ground in the water table and disposal of the contaminated soil.

Command Structure

To understand the complexity of Operation Joint Endeavor and the environmental problems it generated, it is necessary to understand the key commands. MACOMs included USAREUR, which oversaw the environmental operation, and the Office of the Deputy Chief of Staff for Engineers (ODCSNG), a major contributor of manpower and dollars. These two MACOMs were supported by a forward element located in Taszar, Hungary.

The Allied Rapid Reaction Corps, or C-Support, was a multinational command that oversaw U.N. wastes. The Implementation Force was comprised of all allied forces and included Task Force Eagle and the 1st Armored Division. The Base Camp Coordinating Agency (BCCA) was an ad hoc engineer-staffed office formed to assist and support all aspects of the division's base camps. This office was located with the division rear.



A soldier in protective gear deposits waste oil into a 55-gallon container. An overhead cover prevents rain from washing leaks and residue from the container onto the ground.

During the first months of the operation, the staff consisted mostly of USAREUR and ODCSNG environmental personnel. Later, personnel were recruited from the Reserve Components and Corps of Engineer districts. An average of two environmental cadre worked in the ODCSNG forward office and two worked in the Lukavac Coke Plant in Bosnia, affectionately called "Gotham City" by the soldiers. To assist redeployment, the division rear moved operations to Slavonski Brod, Croatia. Brown & Root Services Corporation provided cleanup support and supplies and constructed hazardous waste sheds.

Environmental Program Tenants

The environmental program supporting Task Force Eagle incorporated four areas:

- Environmental surveys
- An assessment program
- A closure team
- A cleanup and remediation program

Environmental Surveys. To ensure a sound base, the environmental program concentrated first on baseline surveys to measure existing pollution. These surveys documented remediation actions required to protect our soldiers and avoid U.S. liability later. These initial surveys included base camps and

facilities used for billets and office space. Documentation described water source conditions, soil, natural resources (including endangered and threatened species), and air quality. Final surveys measured suspected environmental damage resulting from Operation Joint Endeavor by comparing current conditions with those recorded on the baseline surveys.

The Corps of Engineers contracted Brown & Root to complete the baseline and final surveys, which were somewhat constrained because the time of year did not permit an accurate picture of land and facilities. In many cases, previously contaminated areas were discovered only after the spring thaw.

Assessment Program. Because all environmental programs rely heavily on prevention, site inspection was critical. All unit hazardous waste collection sites in Hungary, Croatia, and Bosnia were inspected. The Base Camp Assessment Team (BCAT), an arm of the BCCA, assessed and monitored base camps during both sustainment and closure phases. The sustainment mission included visits to all base camps and forward operating points south of the Sava River (the border of Croatia and Bosnia) at least once each month. At the close of the visits, base camp mayors (appointed officers who coordinated all base camp activities) received a completed assessment checklist. The checklists graded areas such as the hazardous waste collection point, the POL transfer point, hazardous waste management, spill prevention, and the base camp's overall environmental program.

The standards for the hazardous waste collection points required that units provide overhead cover and secondary containment for liquid wastes, label all containers, and indicate the availability of material safety data sheets and hazardous waste inventory sheets. As with all successful programs, command emphasis was very important. Since the Army recycles waste oil, it was necessary to segregate wastes at unit level before turn-in. For the most part, soldiers were environmentally conscientious, but some neglected to read hazardous waste drum labels. Invariably, some used oil filters ended up in the oily rag or used oil container, requiring additional resources to re-sort the wastes. Spill reaction teams were monitored during assessments to determine the time they needed to clean up spills rapidly.

Since major spills of hazardous substances can generate complex technical, legal, and public relations problems for U.S. forces, fast response procedures to report, respond to, and control accidental discharges of POL products and other hazardous substances were stressed to the units. POL spills (JP8 [jet petroleum] fuel) normally posed the chief environmental risk for U.S. forces. Most soil, ground-water, and surface-water contamination from POL and BTEX (primarily consisting of benzene) occurred at fuel transfer facilities when gas tanks were over-filled or nozzles were dropped while filling the tanks.

Base camps were required to have appropriate spill response materials on hand and to clean up spills within their capability. Spills larger than 25 gallons required contractor help from Brown & Root. The BCCA maintained a database of spills exceeding 25 gallons. That information assisted units as they

departed base camps, real estate personnel as they closed leases, and claims personnel as they addressed damage claims to property used by U.S. forces.

As an assessment tool, base camps were assigned color-coded status slides depicting their readiness assessments. These assessments were featured at the 1st Armored Division's daily battle update brief.

Closure Team. To facilitate clearing base camps in a timely manner with minimal environmental impact on the mission, the BCAT team provided sustainment assistance and closure information. Base camps prepared an environmental condition report and a list of possible contaminated sites and identified the engineer requirements needed to repair and restore maneuver damage. This information was later used by real estate and claims personnel during claims processes. A final checklist signed by a representative from the environmental office and tenant leaders cleared the unit of further responsibility.

Cleanup and Remediation. Cleanup and remediation of contaminated sites were performed to the extent possible under the operation's constraints. The primary concerns were to reduce immediate threats to human health and the environment, determine legal responsibilities, and maintain the good name of the U.S. Army. Based on the preliminary assessments and site characterization, the ODCSENG forward element determined if remediation was required. Decisions to remediate were based on several variables:

- If the site posed an imminent, substantial health threat to U.S. military forces.
- If remediation reduced the liability of the United States.
- If remediation was required by international agreement.

Environmental contractors hired by the Corps or the Defense Reutilization and Marketing Office (DRMO) determined appropriate remediation techniques and the action process schedule. Natural attenuation with no anthropologic control was the desired course of action. If remediation was attempted, two treatment goals were considered:

- 5,000 milligrams of TRPH/kilogram of soil, as measured by the Environmental Protection Agency Method 418.1
- 5,000 milligrams of POL/kilogram of soil, as measured by Petroleum, Oil, and Lubricants - Mineral Hydrocarbons (DIN 38 409, H18)

A question that often arose during base camp cleanup was whether to clean up hazardous wastes left by previous tenants, such as the United Nations. This problem surfaced at several places, including Camp Pleso, Croatia, and Camp Rumbaugh, Bosnia.

Lessons Learned

The following environmental lessons learned during Operation Joint Endeavor may assist units deploying to similar missions:



Secondary containment for liquid wastes protects the environment if the primary container leaks. The sandbags and plastic shown here ensure that no waste fuel will leach into the ground if the drum leaks.

Environmental Surveys

Problem: Incomplete surveys. Because of the urgency to deploy, many base camps had incomplete environmental baseline surveys. Since deployments occurred during winter, most base camps were under several inches of snow and ice. The harsh conditions made surveys difficult to complete, so some included inaccurate data.

Recommendation: To facilitate rapid deployment, begin baseline environmental surveys immediately (preferably by a designated contractor) and treat them as "working documents." The base camp mayor should document sites as accurately as possible. Video and still photographs are the best tools for corroboration. Historical data is also important and should be available for most government buildings and factories.

Prevention Program

Problem: Lack of spill materials. Units brought spill materials to the theater, but only as an afterthought. Spill materials were usually the last items to be shipped. Generally speaking, they are not the most important items when going to war. Units eventually rushed to order these materials, only to find that delivery required weeks or months. The BCAT team finally ordered absorbent materials for the entire division. To supplement the shortage, the Corps of Engineers used its Rapid Response Contract to purchase additional absorbent materials, which were distributed to all base camps. Also, some supplies that were originally misplaced were found in various base camp warehouses throughout the theater.

Recommendation: Units need to transport a basic load of environmental cleanup and storage supplies during deployment. Once deployed, they should order and track additional supplies. The Corps should coordinate pre-existing contractor support for

contingency purposes.

Problem: Washrack discharge. Too often, because of expediency and lack of real estate, washracks were built near creeks. As a result, discharge ran directly or indirectly into streams. But this wasn't the extent of the pollution; the main damage was from vehicle runoff sludge, which included heavy metals (cadmium).

Recommendation: Base camps may lack sufficient land and must make-do with the space provided. If no suitable alternative site is available, environmental controls (such as absorbent pillows and booms) should be placed at the washrack. Unit personnel should periodically deposit sediment in containers stored at the site to prevent heavy metals from polluting nearby streams. Base camps should test the sediment to ensure that heavy metals have not contaminated areas downstream.

Base Camp Closure

Problem: Clearing base camps. Successful base camp closure was very important to the overall mission of Joint Endeavor. Recurring problems cropped up during the first wave of closures. Often, base camp leaders were unaware of solutions for maneuver damage, such as dismantling hesco bastions (prefabricated metal/cardboard shells filled with soil), disposing of gravel, and clearing firing ranges and burn pits.

Recommendation: Key personnel, including representatives from real estate and the environmental contractor, should visit a base camp at least six weeks prior to closure. They should identify specific remediation responsibilities during this visit. Assessment personnel must conduct follow-up inspections during the last two closure visits to ensure that the remediation actions have been accomplished.

Cleanup and Remediation

Problem: Transportation of hazardous wastes. Because of the sensitivity of hazardous wastes, some countries imposed strict limits on the transportation of these wastes through their area. Normally, the Army's environmental policy calls for the DRMO to transport all hazardous wastes from a central collection point to remediation sites. A problem occurred when Croatian officials refused permits to DRMO's subcontractor to transport wastes from Croatia to Germany, effectively bottling up the disposal system. At one point, Implementation Force vehicles transported the hazardous wastes, although this action was not entirely within the letter of the agreement. The problem was eventually elevated to the highest level of the command structure, but no satisfactory solution was reached.

Recommendation: During deployment operations, Army staff must coordinate with host country officials as early as possible. Although constrained diplomatically, the United States must firmly set operating limits with the respective country. If this fails, the staff must aggressively search for in-country disposal sites that meet our standards. To preclude this problem, the staff may prepare agreements with cooperative countries authorizing the collection of hazardous wastes and the transportation of wastes out of the country.

Problem: Leakage from containers. Arriving MILVANS (military-owned demountable containers) and CONEXes (container expresses) often leaked at the ISB. Some hazardous waste materials were improperly transported from Bosnia through Hungary for turn-in to Germany. For example, one shipment of hazardous materials contained undrained batteries. Operation Plan (OPLAN) 4243 specifically describes shipping standards for hazardous wastes.

Recommendation: Transporting hazardous materials without taking proper precautions (such as draining battery acid) and transporting hazardous wastes are prohibited. Transport personnel must be briefed on the hazardous materials included in any shipment, including health risks of exposure and the physical hazards of the material. The chain of command must continually train soldiers to properly load and secure CONEXes.

Problem: U.N. hazardous wastes. The disposition of hazardous wastes left by former U.N. agencies and countries at sites occupied by U.S. forces created potentially embarrassing problems. Several base camps contained large quantities of used POL products left by previous tenants. Fortunately, most of the hazardous wastes were left in segregated areas in motor pools and out of harm's way. The U.S. policy regarding wastes generated by other than our forces is simple: We will not clean up other than U.S. wastes unless there is an immediate threat to our soldiers' health.

Recommendation: Continue to enforce the policy that the United States will not add to, transport, or touch hazardous wastes generated by other countries unless they present an

immediate health risk to our soldiers. Unit leaders must immediately coordinate with base camp mayors and the camp's multinational component to safely remove all wastes.

Personnel

Problem: Recruitment of personnel. Although environmental personnel performed superbly during the year-long operation, there were some difficult periods when staffing fell short. Additionally, the frequent changes in civilian personnel caused continuity problems. Originally, personnel were recruited from only one source—the ODCSENG office in Wiesbaden. This restriction made it difficult to fill positions.

Recommendation: To ensure an adequate number of personnel, the U.S. Army should not limit recruitment to a single source. Engineer districts and other governmental agencies are excellent sources of qualified employees. To ensure continuity, civilians should be assigned on a temporary status for a period of not less than 90 days. This will allow 60 days on station, including travel and one week of training in Hohenfels. (This training is mandatory for all personnel deployed to the ISB/Bosnia.)

Conclusion

The Army's superb effort during Operation Joint Endeavor resulted in the fewest nonbattle injuries of any deployment in U.S. history. Some of this credit can be attributed to a successful environmental program. A result of this program is improved quality-of-life for soldiers. This includes reduced health risks as well as additional comforts during extended deployments—bought with money saved on site remediation.

To ensure continued environmental success in the field, units must keep accurate records on their baseline through final environmental surveys. Units must initiate a sound prevention program with a working assessment process and immediately clean up all spills. If site remediation is required, units must use the best techniques possible within their mission constraints.

Command interest is key to a successful environmental program in the field. Commanders must continually emphasize the importance of accomplishing the Army's mission without adversely impacting the environment. With this emphasis, the Army will be a national leader in environmental stewardship for present and future generations.

Major Litzelman is assigned to the TRADOC Environmental Office as an individual military augmentee, U.S. Army Reserves. He was an environmental project officer with the Base Camp Coordinating Agency, Balkans Office, in support of Operation Joint Endeavor. MAJ Litzelman is a graduate of the Command and General Staff College and the Airborne and Ranger Schools. A civilian environmental contractor, he provides support to the Army Environmental Programs Office.



Road Building 101

By Captain Thomas S. Bowers

For Marine Corps combat engineers, road-building missions generally consist of constructing combat roads and trails to enhance the mobility of our forces. This construction involves clearing trees and other obstacles, rough grading the surface, and possibly compacting the surface. Depending on the time available, drainage ditches may be added. By doctrine, road building for Marine combat engineers is not very complex.

This article describes how the Engineer Operations Division constructed Ordnance Point Road at the Marine Corps Air Station, Cherry Point, North Carolina. This project was more than a simple combat road. Because of its location, it had to meet Department of Transportation specifications.

For the sake of simplicity, I break the construction project into seven phases and discuss the techniques used in each. My intent is to highlight how we resolved some of the problems encountered.

Mission and Design

The mission was to construct an 1,800-foot improved-surface road to connect two ammunition supply magazines so that ammunition could be moved within the storage areas without having to exit onto a main road. The completed road required appropriate drainage and erosion-control measures to limit environmental impacts on the surrounding area.

The design called for the first 1,100 feet of the road to be straight and the next 300 feet to include a super-elevated S-curve. Coming out of the banked curve, the last 400 feet would be straight. The curve would be located over the main culvert to help ensure proper drainage. The road was to be a series of cuts and fills. The first 1,100 feet would have cuts from 2 to 6 feet deep, which would provide the fill required to bring the rest of the road up to grade. The only problem we encountered with the design was that it

changed many times during construction. The initial time line for this project was three months, but because of all the changes, it took nine months to complete.

Clearing Operations

In the planning phase, clearing the roadway seemed to be a simple task, but many problems surfaced. The area was a dense forest with most of the trees more than 100 feet tall, and their removal was difficult. My first concern was for unit safety. We cleared the area with D7G Dozers and chain saws and used various types of heavy equipment to load and haul timber to the landfill.

About this time, station environmental protection representatives informed us that we were operating in an environmentally sensitive area and could not continue clearing. Even though we had the required permits and were



Marine engineers dig a trench to emplace a 150-foot culvert.

constructing a base-approved project, work was delayed. No endangered species were in the work area, but it was considered environmentally sensitive because of a small stream that ran across the site. From this point on, environmental constraints impacted every phase of the project.

Culvert Emplacement

The most difficult part of the project was emplacing 150 feet of 6-foot-diameter culvert in the 70-foot-wide by 20-foot-deep natural swale. All water in the surrounding area filtered down to this swale and into a stream that ran across the middle of the road. After surveyors staked out the culvert location, we diverted the stream to one side of the swale. The stream was not a problem, but the swale was a mud pit. We tried using both wheeled and tracked equipment to get down the embankments to dig out the culvert trench, but we only succeeded in getting the equipment stuck. Then the S3 Operations Officer, the only Marine in the squadron with road-building experience, suggested building a series of three steps down the embankment to serve as platforms from

which the equipment could work.

The area was covered with about three feet of muddy topsoil on top of a sand and clay base. As we scraped off the topsoil, subsurface groundwater percolated to the surface and degraded trafficability. Eventually we cut steps into the embankment, but we could not excavate the culvert trench from them because the heavy equipment sank into the mud. We used rolls of fiberglass reinforcing mat, called *Momattin*, from our rapid runway repair kit to stabilize the surface. Covering the steps with the mat allowed the vehicle's weight to spread over a larger area.

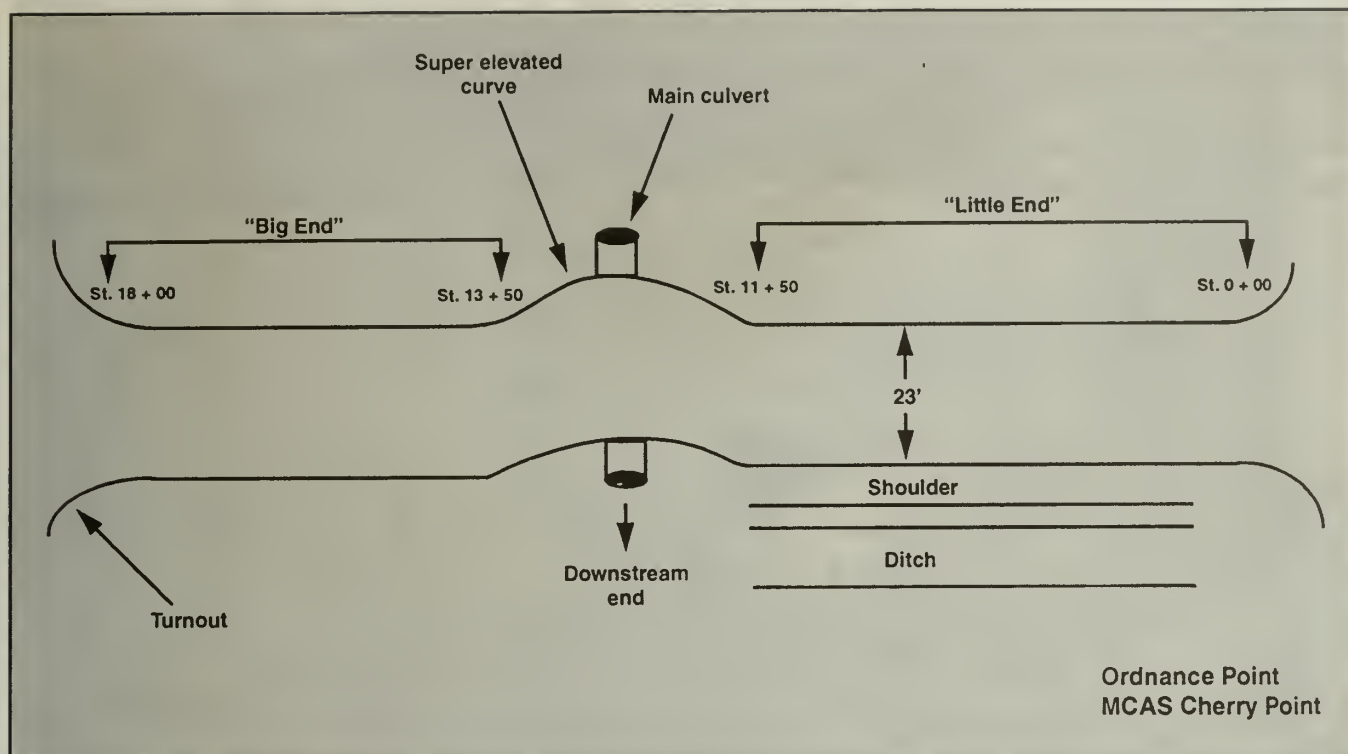
An excavator with a ditching bucket was used to dig a trench 150 feet long by 8 feet wide by 4 feet deep. This took about two days because the excavator could dig only a small section before it had to be moved. The culvert's base was a 3-foot bed of gravel, which trucks dumped into the trench and combat engineers spread with shovels. A high-speed, high-mobility crane emplaced each 50-foot section of culvert, and we sealed and bolted them together. To backfill the trench, we emplaced a 1-foot lift of gravel and five 1-foot lifts of suitable fill. Between each lift, we compacted the

fill. The operation was slowed because only two mechanical compactors were available. In addition, rain filled the trench with water, which hindered compaction.

Fill for the swale was supposed to come from the first section of the road, but due to inclement weather and poor drainage, none could be generated. There were no stockpiles on the base; however, two runways were being resurfaced on the other side of the base, and the old asphalt was being stockpiled for removal by a contractor. The Environmental Affairs Section determined that we could use the asphalt as fill without adversely impacting the environment.

The five dump trucks in our squadron could not haul enough asphalt to support the backfill operations, so we borrowed trucks from other squadrons. The area around the culvert required 21 feet of fill to bring it up to the required subgrade. Again, each 1-foot lift was emplaced and compacted before the next lift was added. Although this was time consuming, it enhanced the California Bearing Ratio (CBR) of the road.

The two major problems in this phase of construction were terrain and



weather. Poor trafficability of the existing soil and frequent rains caused this phase of the project to take almost two months.

Preparation of the Road Surface

The temporary drainage ditches eliminated flooding on the existing road surface. We began working on the "big end" (St. 13+50-St. 18+00), which was mainly a fill area. After shaping and leveling the ground, we layered crushed asphalt to bring the road surface up to the required subgrade and cut in the shoulders and rough ditching.

As work on the big end neared completion, surveyors marked the cut and fill locations on the "little end" (St. 0+00-St. 11+50). Since this part of the project would generate a surplus of fill, we suggested to the facilities engineer that we not make all of the cuts but just level the 1,150 feet and improve the drainage. This plan would not adversely affect trafficability or the CBR of the road and would speed up the operation. The idea was rejected because new ammunition bunkers were being constructed in another part of the

storage area and the fill to cover them would have to be purchased. If we could generate the required fill, it would save the Marine Corps Air Station thousands of dollars.

After attempting to make the cuts with D7G and 1150E Dozers, then pushing the fill into a pile and moving it with our TRAM scoop loaders to the stockpile site adjacent to the road, we realized that this operation could take months. We needed a piece of heavy

equipment that could both cut and move large amounts of fill. The 621B Scraper can do this, but in 1993 the Marine Corps decided that Marine Wing Support Squadrons did not need such equipment, so they removed our two scrapers. The 8th Engineer Support Battalion at Camp Lejeune, North Carolina, loaned us one for the duration of the project.

The bowl of the 621B Scraper has a capacity of 18 cubic yards. We used the



Excavation continues.



Erosion-control measures included lining the ditches with riprap.

push-loading method: a D7G Dozer pushed the scraper to fill the bowl, since the scraper lacked the power to make cuts in the muddy terrain. Two passes with the scraper equal about four passes with a dozer.

Drainage

The drainage plan included adding ditches along each side of the road, installing several culverts, and constructing two swales to channel water flowing out of the ditches and into the surrounding forest. Since a small stream is channeled through the 150-foot culvert we installed, extensive erosion-control measures were required. The 3-foot bed of gravel that the culvert rests on prevents the ground from eroding away, which would cause the culvert to shift or sag and the road to fail prematurely. The gravel bed also ensures that groundwater below the streambed is released before it filters up to the road subgrade. In theory, once the ground is tightly compacted, groundwater will filter upward. By providing a relatively

uncompacted layer of stone below the surface, water moves on the horizontal axis and exits at the end of the culvert. To ensure that the gravel bed would not become as compacted as the surrounding soil, we placed a layer of synthetic geotextile fabric in the trench before laying the gravel. The multilayer weave of the fabric allows water to pass through it and keeps sand and silt from building up on the gravel. This fabric is the primary erosion-control measure under the entire road surface, and it lines the drainage ditches and swales.

When the road was at subgrade, we added two 18-inch-diameter culverts 3 to 4 feet below the surface. One is at St. 17+90; it is a control measure to ensure that excess water from the upstream side of the road can flow under the road and into existing ditches. We emplaced the other culvert at St. 6+50 so that ditches on the upstream side of the road can drain before reaching the main culvert.

The ditches for this road are trapezoidal. A shallow "V" ditch would have silted up too quickly, and a deep "V" ditch would have been more difficult to emplace and tie into the existing ter-

rain. The trapezoidal ditches have a front and back slope ratio of approximately 3:1, with the slopes meeting at the flat bottom of the ditch. We lined the ditches with riprap (5- to 7-inch pieces of coral), another erosion-control measure, which also slows the accumulation of silt throughout the length of the ditch.

Low areas in the surrounding terrain made ideal locations for constructing two swales, which allow the ditching away from the main culvert to empty back into the woods and help prevent overflow during severe storms. We used an 1150E Dozer to widen, flatten, and extend each natural swale and then covered them with riprap.

Our drainage and erosion-control plan may seem extreme, but since the road was constructed in an environmentally sensitive area, the potential effects of excessive silt runoff on a nearby lake were a major concern. We know that our drainage system works well, because during construction it rained almost every day. We could see potential problems and correct them before the project was completed.

Final Grade and Surfacing

The last construction phase involved bringing the entire road surface up to the final grade by adding additional lifts of "crush and run," which consists of crushed stone and small 1- to 2-inch stone. Even though we simultaneously spread it on the little end with the 621 Scraper and on the big end with dump trucks and a 130G Grader, completing the task was an extremely slow process. The area to be covered was 1,800 feet long by 23 feet wide. Each pass with the scraper covered about 40 feet. Then the scraper moved to the crush-and-run stockpile where it was loaded by a scoop loader. The dump truck and grader combination was no faster. As a 1-foot lift was completed at each end, a smooth-drum compactor made approximately 10 passes to ensure that the crushed stone was well-compacted. Some areas only required one lift, while others required two or three. At this point, rainy weather helped us in two ways:

- It controlled the dust from the stone and kept it from obscuring the operator's view.
- It facilitated the compaction process.

The last section of the road to be brought up to final grade was the main culvert area. We shaped the super-elevated curve over the main culvert with the last two crushed-asphalt lifts. Asphalt provides an excellent base material for the curve, since it increases resistance to the shearing effects of heavy loads. Asphalt is also easier to shape than crushed stone.

The main problem we had in this section of road was trying to spread stone with the grader while maintaining the super elevation. Once we spread the stone, the compactor had to roll the area without flattening the slope. When compacting was finished, we identified high and low spots and filled or cut them using a grader.

Completion

During the nine months spent on the project, the surrounding area had been scraped and plowed and had tire ruts everywhere. As we cleared more and more area for ditching and runoff, we stockpiled the fill and debris off to the side. Each of these piles had to be moved and consolidated into one large pile for the bunker project. Large tree stumps dug out during construction had to be hauled away, and damaged trees had to be cut down and removed. We also removed the silt fencing used to protect the stream during construction and cleared and graded approximately 40 feet on each side of the road.

In open areas, we sowed grass seed and covered it with straw. Where there were trees and bare topsoil, we added mulch for erosion protection. We placed riprap in the ditches and around the main culvert. A fencing contractor had installed gates at each end of the road about one foot above the final grade. From a security standpoint, the gates could be easily breached; in addition, they were not aesthetically pleasing. We pulled the corner posts, reset the gates to an appropriate height, and anchored them with new concrete. At last we were ready for a final inspection by the facilities maintenance engineers.

In the main portion of the inspection, the engineers compared the as-built plans with the original plans to ensure that changes made during construction were authorized by the design engineers. Once they were satisfied that the road was properly constructed, the engineers conducted a walk-through that emphasized the drainage and erosion-control measures. They were satisfied with the end product but added two more tasks:

- Dig out the silt buildup at the downstream end of the main culvert.
- Remove a small concrete culvert that restricted the flow of water upstream.

After completing these tasks, the road was officially finished, and it was time for the ribbon-cutting ceremony. The entire squadron witnessed the ribbon cutting and road dedication. The Marine Corps Air Station commanding general presented five Navy Achievement Medals for the hard work and dedication that went into this project.

Lessons Learned

I learned many valuable lessons from this project.

- Do not overestimate the capabilities of your unit. The squadron commander committed the engineer division to the project knowing that we lacked adequate training or experience. The positive effect was that the project allowed the equipment operators to become thoroughly trained. Some of these Marines had only a few hours of operating time on various pieces of heavy equipment when this project began. By the time we were finished, each operator had attained a high level of proficiency on several pieces of equipment.
- Learn to cope with various command relationships. Throughout the project it seemed that everyone on base was directing the project, including facilities engineers, environmental representatives, design engineers, and my supervisors. This was a case where using the chain of command was crucial. If someone outside of my chain of command wanted to change something, they first had to convince my commander. This allowed me to build the road as it was designed and retain control of what happened at the work site.
- When you are in charge of a project, manage your resources wisely. Adjust the time line to meet changing demands. Keep your unit informed about all aspects of the

(Continued on page 23)

Being A Terrain Visualization Expert

By Colonel Edwin Arnold

In 1995, the Commandant of the U.S. Army Engineer School directed the merger of the Topographic Engineer Officer specialty (21C) with the Combat Engineer Officer specialty (21B). Nearly coincident with this decision, the Commandant began delivering the message that engineer officers, regardless of specialty, are the terrain visualization experts for the organizations in which they serve. These two pronouncements have met some resistance within the engineer community—from captains in the Engineer Officers Advanced Course, who believe instruction on topographic products and terrain visualization processes may be a waste of their time, to topographic engineer warrant officers, who see this as a move to take their jobs. Let me take a few minutes of your time to explain my twist on this issue.

First, you need to understand that I am not some "topo guy" trying to sell his career pursuits. I once attended the Mapping, Charting and Geodesy Officers Course, but that was many years ago and I have never served in a topographic assignment. I am a combat engineer with more than eight years of service in three divisions, both in the United States and in Europe, as a field grade officer. My thoughts on the subject of being a terrain visualization expert have their roots in that experience and the combat engineer education and experiences that preceded those assignments.

"Maneuver commanders must know they can turn with confidence to their engineers to assist them in the critical function of 'visualizing' the terrain."

Why Me?

Is being the terrain visualization expert within your organization important to you as an engineer, and should every engineer officer be able to perform that role? I strongly believe the answer to that question today is "yes." I also believe that the answer becomes a more emphatic "yes" as we move the Army into the 21st century. But, before I progress too far in that discussion, let me clarify some points that partially address the warrant officers' concerns that we commissioned officers are out to steal their jobs.

In this short discussion I am talking about *terrain visualization*, not *terrain analysis*. There is a difference. Terrain visualization is the process through which a commander sees the terrain and understands its impacts on the operation in which he is involved, both on friendly and enemy elements. It includes the identification and understanding of those aspects of the terrain that can be exploited by the friendly commander

to gain advantage over the enemy as well as those aspects most likely to be exploited by the enemy. It is a subjective evaluation of the physical attributes of the terrain as well as the physical capabilities of the vehicles, equipment, and people that must cross over or occupy the terrain. Terrain visualization is closer to military art than to military science.

Terrain analysis, on the other hand, is military science. It is the study of the properties of terrain and how those properties change over time with use and changing weather. Terrain analysis is the basic science of the study of terrain. It starts with the collection, verification, processing, revision and, in some cases, the actual building of available source data. In short, terrain analysis turns basic data into usable information. Terrain analysts then synthesize the data to produce products that portray the effects of terrain. These products are basic tools that facilitate the terrain-visualization process. Terrain analysis is a very technical process and requires the expertise that topographic warrant officers possess.

Terrain Experts

With that clarification, let's return to the basic discussion—the importance of being a terrain visualization expert. We, the engineers, are the mobility and countermobility experts for the Army. We do other things also, but our role as members of the combined arms team is largely comprised of mobility and countermobility operations.

We cannot effectively do either of these functions without a comprehensive understanding of how terrain affects the movement of friendly and enemy forces. In our beginning education as young engineer lieutenants, we are taught how to site obstacles for the greatest effect. You could call this "Terrain Appreciation 101." No other member of the combined arms team receives such education. They may receive the basics in how to identify key and decisive terrain, but the nuances of how terrain affects the movement to and from that decisive terrain is taught only to engineers.

In reality, we practice our terrain visualization expertise every day, generally without giving it a second thought. Every time we advise a commander on the correct placement of an obstacle or obstacle belt to achieve the desired effect, or recommend shifting a battle position to achieve better engagement area coverage or gain increased survivability, we are using our terrain evaluation skills to assist the supported commander in "visualizing" terrain effects. In support of the offense, we help define where the enemy might set defenses based on the limiting effects of the terrain, or where he might emplace obstacles to create advantage from the opportunities afforded by the terrain. We do this throughout our careers at every level of command and staff. As a division engineer, both as a battalion commander and later as a brigade commander, the division commander expected me to study the area of operations and to advise him of the opportunities it offered for us to gain advantage over the enemy.

So, the idea of being the "Terrain Visualization Experts" for the Army is really nothing new. It is something that we, as well-trained engineers supporting our maneuver commanders, have always done, and it is an important contribution to countless successes on the combined arms bat-

tlefield. As the Army moves to the 21st century, this contribution will grow in importance as dispersed, noncontiguous operations and greater reliance on increased mobility expand the battlespace and increased tempo reduces the time available to see and understand battlespace effects. Maneuver commanders must know they can turn with confidence to their engineers to assist them in the critical function of "visualizing" the terrain. As the tempo of operations increases, our ability to modify the terrain to our advantage decreases.

Moving Ahead

On future battlefields, we will be forced to rely heavily on wielding terrain as it already exists as a combat multiplier. We can do this if we clearly understand the terrain and its effects on the men and machines that move on it.

The transition to digital topographic data and the increasing capability of our terrain-analysis tools will permit the technical experts (the topographic engineer warrant officers) to provide increasingly complex analysis products. These products will increase our understanding of the terrain and its effects. When coupled with our knowledge of friendly and enemy capabilities and intentions, these products will help us identify the terrain effects to be exploited. Then we must impart this knowledge to the commanders we support. We must help them visualize the terrain early in the planning process so our forces can exploit its effects to our advantage. That is the engineers' role. After all, we (the topographic engineer warrant officers and the combat engineers) are the experts!

COL Arnold, currently assigned to Fort Leonard Wood, serves as Director of Battle Lab Support in charge of the Maneuver Support Battle Lab. He is also the interim TRADOC Program Integration Officer for Terrain Data (TPIO-TD).

(Continued from page 21.)

project, and ensure that they understand why something is done a certain way. When you must work on weekends to maintain the time line, be creative in your efforts to keep up morale. These are a leader's obligations.

- When planning a project, try to anticipate events or factors that may impede progress. Weather and terrain may influence construction projects dramatically. Building a road during the cold, rainy winter in North Carolina is not a good idea. The ground may be solid and dry during the summer, but it is muddy and flooded in winter. Be aware of training and deployment schedules. It would not be wise to begin a project and then lose half of the unit to a deployment.
- As a leader you must set the example. You must do anything that you ask your unit to do. You must be a teacher, a counselor, and a role model. You must earn their trust and confidence.

No one can control all of the factors that affect a construction schedule. During the construction of Ordnance Point Road, I had daily operations meetings to attend, formations and inspections to conduct, and concurrent projects to oversee. There will always be some resource constraints in any construction project. Personnel, time, and equipment are your most valuable resources. The success or failure of the project depends on how well you use these resources.



Captain Bowers serves with the 8th Engineer Support Battalion, Camp Lejeune, North Carolina. He previously served as the Engineer Operations Division OIC, MWSS-274, MWSG-27, 2d MAW, Cherry Point, North Carolina. CAPT Bowers is a graduate of the Engineer Officer Advanced Course, Fort Leonard Wood, Missouri.

A New Way of Doing Business

By Major General Clair F. Gill and Vern Lowrey

The U.S. Army constantly upgrades and changes the way it fights to maintain battlefield superiority over all potential adversaries and to achieve complementary capabilities with other services and nations. In that effort, the Army is changing from what we called CBRS (Concepts Based Requirements System) to a new requirements determination process. The CBRS had distinct stages in research and concept development that focused primarily on the manufacturing and fielding of equipment to counter a single, well-defined threat. The new requirements determination system is a fluid, integrated, experimentation-based process that addresses an expanded global threat and the full spectrum of Army operations and functions.

The new process began in March 1996 with publication of TRADOC's Black Book number 3, "Requirements Determination." General Reimer, Chief of Staff of the Army, appointed the TRADOC Commander as the Army's approval authority for all warfighting requirements. A soon-to-be-published TRADOC Pamphlet 71-XX, *Requirements Determination Guide*, will describe implementation methods. It will provide process details needed by action officers throughout the Army to determine, document, and process concepts, future operational capabilities, and DTLOMS (doctrine, training, leader development, organization, materiel, and soldiers) requirements. To implement this process at the Engineer School, we now conceptualize, experiment with, and invest in future warfighting capabilities for the engineer force.

Conceptualization began with development of Army Vision 2010. This vision is being refined into an overarching warfighting concept that links the Army vision with the National Military Strategy, the joint vision, and the Army plan. The overarching warfighting concept guides all other Army concept development activities, including additional functional and branch concepts.

The Engineer School has developed an overarching vision for engineer operations and three branch concepts in the areas of terrain visualization, maneuver engineering, and force support engineering. They are now staffed to the field for comments.

We have created several integrated concept teams (ICTs) to support the engineer concept areas. They are chartered to provide horizontal integration and detailed coordination between Army agencies, units, labs (USACE and AMC), joint services, contractors, and civilian industries. The ICTs develop concept details, assess the state

of current technologies, develop modernization strategies and experimentation plans, and draft investment strategies for engineer DTLOMS improvements. The ICTs presently sponsored by the Engineer School include:

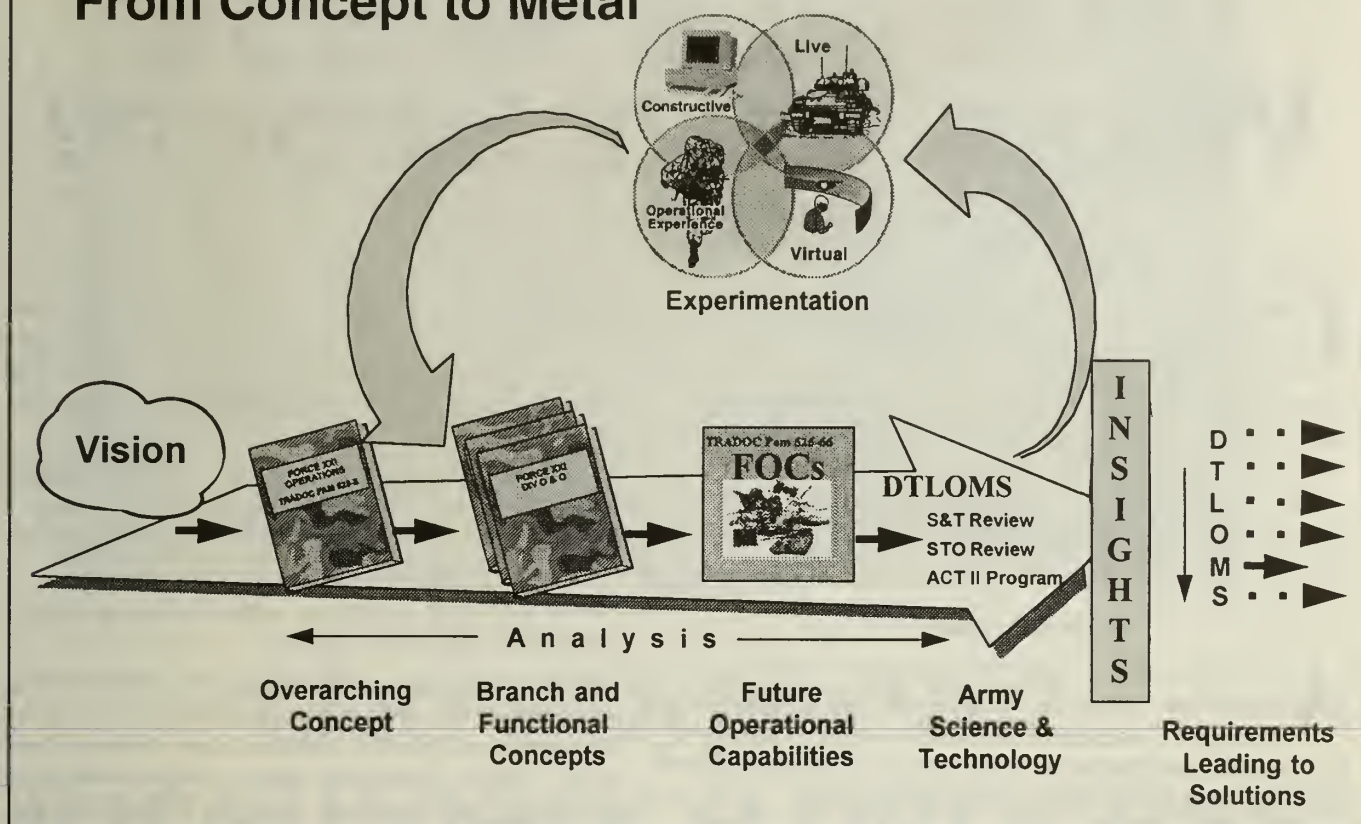
- Countermine
- Terrain Visualization
- Construction
- Unmanned Terrain Domination
- Engineer Command, Control, Communications, Computers and Intelligence
- Armored Engineering

In turn, the vision and warfighting concepts are used to develop future operational capabilities (FOC). The FOCs are structured statements of enduring operational capabilities required by the Army to achieve the ideas articulated in the approved warfighting concepts. Science and technology research, experimentation, and schoolhouse investments are all tied to accomplishment of an FOC. The Engineer School has developed 30 FOCs, which are integrated with other proponent FOCs at TRADOC.

Warfighting Experimentation and analysis are key to the requirements determination process. When properly planned and executed, warfighting experiments provide the means to recommend future warfighting DTLOMS investments. The Engineer School is decisively engaged with the 4th Infantry Division, which serves as the Army's Experimentation Force (EXFOR). They perform experiments to identify future engineer DTLOMS requirements. In March and November 1997, the EXFOR will conduct advanced warfighting experiments at the National Training Center and Fort Hood, Texas. Army leaders will examine several engineer-related issues, including terrain visualization support, Hornet wide-area munitions, intelligent minefields, the digital reconnaissance system, and the future heavy engineer force structure.

Observations from train-ups to both experiments show that engineers are a critical component to the digitized combined arms team. Digital command and control systems require intensive operator and leader training. Mastery of basic combat engineer skills, such as obstacle breaching, obstacle emplacement, and survivability, are still essential for combined arms success. Providing a heavy division engineer battalion in habitual support to a brigade task force continues to be tactically correct. The

"From Concept to Metal"



most critical deficiency identified during recent experiments is the need for accurate digital terrain displays in digitized command posts and combat vehicles. Army decision-makers are painfully aware of the lack of standardization in the way we acquire, analyze, transmit, store, and display digital terrain data. Therefore, TRADOC has tasked the Engineer School to lead the attack on this problem through a TRADOC Program Integration Office (TPIO) for Terrain Data, located at Fort Leonard Wood. Colonel Ed Arnold's Personal Viewpoint (page 22) describes the many challenges we face in standardizing the ways digital terrain data are used.

In addition to EXFOR experimentation, we have established the Maneuver Support Battle Lab at Fort Leonard Wood. This newest Army Battle Lab is charged to conduct experiments in all aspects of maneuver support. It is the advance guard of the Military Police and Chemical Schools' move to Fort Leonard Wood in 1999 to form the Maneuver Support Center (*Engineer*, December 1996, page 40).

Proper Investment in the appropriate DTLOMS areas to achieve future operational capabilities is the final payoff of the new requirements determination process. Most of the Army's requirement efforts will continue to center around developing the "M" in DTLOMS—materiel. Because materiel solutions are the most time consuming and expensive to develop and acquire, we engineers are

challenged to find new and better ways to write doctrine, conduct training and leader development, build organizations, and "grow" our soldiers. The engineer equipment and technologies we develop and exploit now will focus on those few systems that will give us the most bang for the buck. Some key items under development are the Grizzly, the Wolverine, the Hornet, and the IMF (soon to be renamed Raptor Intelligent Combat Outpost).

The new requirements determination process may look similar to CBRS and previous Army requirements processes. But it recognizes the engineer community's need to continually conceptualize, experiment with, and realistically invest in those critical engineer warfighting capabilities that will provide the U.S. Army with overwhelming dominance over any foe.



Major General Gill has served as Commandant, U.S. Army Engineer School and Commanding General, U.S. Army Engineer Center and Fort Leonard Wood, Missouri, since June 1995.

Mr. Lowrey serves as technical director of the Maneuver Support Battle Lab at Fort Leonard Wood. He is commander of the 1138th Engineer Battalion (First Missouri), Missouri Army National Guard.

CAPTAINS AS S3s: WHAT'S THE SCOOP?

By Captain Mike Brobeck

If you haven't heard discussions about captains (promotable [P]) or captains serving as battalion S3s (Operations and Training Officers) yet, you may. It isn't a program, it's an exception. There are currently more requirements for majors than there are majors available. This is true Army-wide, not just in the engineer branch.

This is not the first time the Army has found itself in a position to place captains in S3 positions. It also happened in the early 1980s.

Ground Rules

Anticipating that it may be necessary to place captains(P) or captains in S3 positions, the U.S. Army Personnel Command (PERSCOM) is ready to guarantee 12-month stabilization for these officers. However, some conditions must be met before exceptions are made:

- There are no majors in the brigade or division or on an installation, regardless of military education level (MEL-4) status, who can fill the position.
- Prior coordination is accomplished with the Engineer Branch of PERSCOM.

Branch Qualification

A concurrent issue is branch qualification. While TRADOC determines what constitutes branch qualification, PERSCOM's assignment policy will be to follow these guides:

- Captains (P) who serve as an S3 for a minimum of one year will be considered as having served their duty with soldiers as a major; they will not be routinely considered for additional duty with soldiers as a junior major. Some may serve again in their senior years as a major.
- Captains who serve in these positions will not be considered fully developed. During their early years as a major, they will be returned to troop units for further development.

Implications

If there is such a shortage, why can't I get to a troop unit? The Army's leadership determines the relative priority of personnel filling an organization. This translates into an officer distribution plan that stipulates the number of officers by grade and specialty who can be assigned to an

organization. Due to the shortage of majors this fiscal year, many organizations have a higher priority of fill than do troop units. This translates into fewer opportunities for majors to be assigned to troop unit installations during the fiscal year.

As a major, how do I get to be an S3 or executive officer (XO)? There are two ways to position yourself on or near a troop installation to increase your chances of getting into the queue for an S3 or XO position:

- Seek a short-tour assignment with a follow-on assignment back to a troop installation.
- Seek an assignment to a major command or field operating agency that is collocated on a troop installation (such as the Intelligence and Security Command, Army Materiel Command, Forces Command Active Component/Reserve Component, or Operational Test and Evaluation Command). Once there, contact the senior engineer commander at the installation and your assignment officer at PERSCOM to express your desire to serve as an S3 or XO.

I'm a major who walked right into a branch qualifying job. Will I be reassigned once I have served for 12 months as an S3 or XO and have 12 months on station? This is a possibility, based on other requirements for engineer officers. However, the Engineer Branch will make every effort not to move a major and his/her family after one year on station.

Conclusion

The key to success is communications! The Engineer Branch will continue to strive for that ultimate "win-win" assignment for the officer, the unit, and the Army.

For information or assistance, contact Major Scott Dias, Engineer Majors Assignment Officer, at (703) 325-5697 or e-mail diass@hoffman-emh1.army.mil; or Lieutenant Colonel Dave Ridenour, Engineer Branch Chief, at (703) 325-5693 or e-mail ridenoud@hoffman-emh1.army.mil.



Captain Brobeck is the Future Readiness/Professional Development Officer, Engineer Branch, PERSCOM. Previous assignments include Advanced Civil Schooling Program Manager, PERSCOM; Commander, C/307th Engineer Battalion, 82d Airborne Division; USASOC DCSENG Plans Officer; and PL/XO, 16th Engineer Battalion, 1st Armored Division.



the engineer intelligence process

By Captain Cynthia A. Glenister and Major John E. Richerson

“S2...S2!? What do you mean I’m going to be an S2? I’m an engineer, not an MI officer.” More than a few engineer officers have found themselves repeating those or similar words. With the shortage of MI officers in the Army today, the chances of a young engineer captain being assigned as an S2 of a combat engineer unit probably are very good. By sharing some knowledge gained while assigned to engineer units, we hope to provide those of the “non-MI” persuasion who find themselves in an intelligence position with information that will make the job an easy one. We will briefly discuss some general intelligence production requirements and then describe some engineer-specific intelligence products and presentation techniques.

Intelligence Requirements

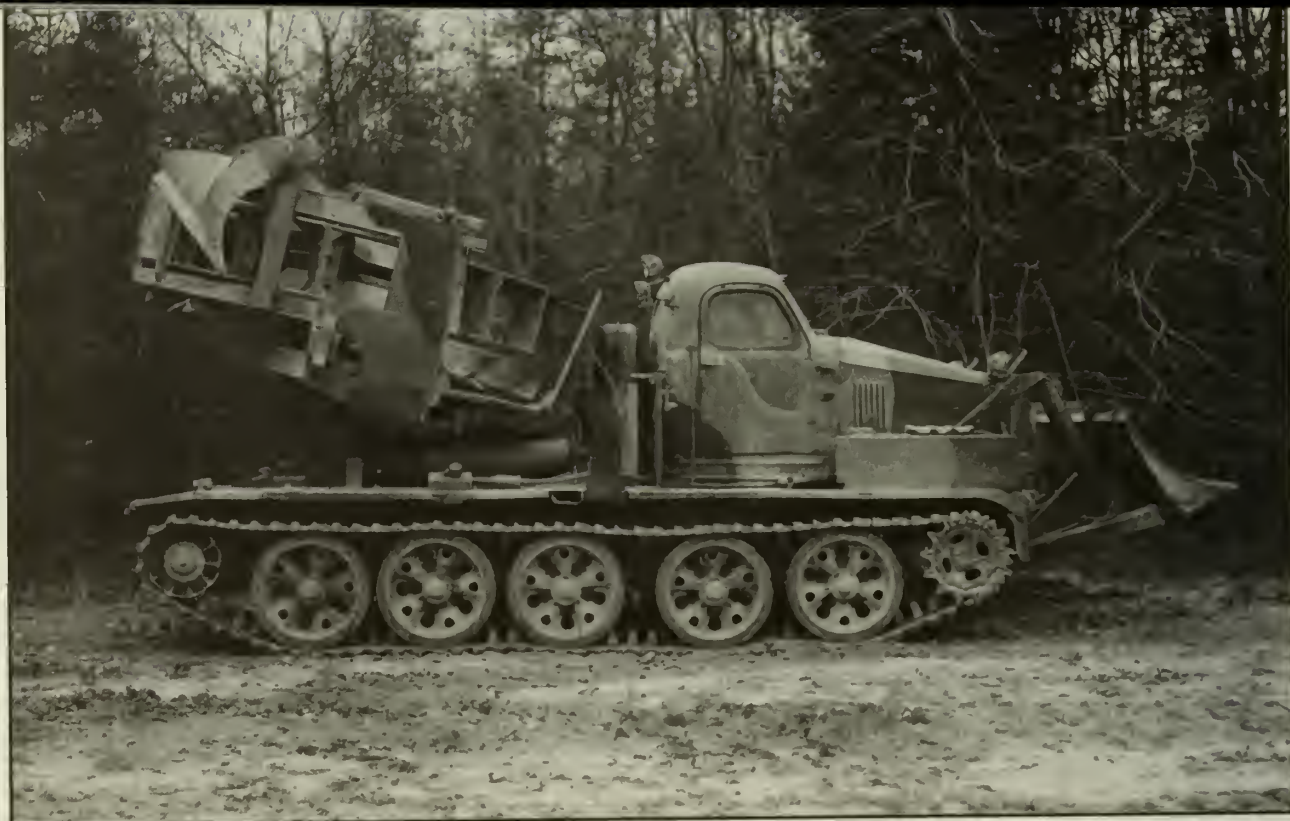
In any Army unit, the focus of intelligence efforts always depends on METT-T (mission, enemy, terrain, troops, and time available). The situation, driven by METT-T, influences the commander and the S2 in determining the intelligence support required for mission success.

How does one determine the kinds of intelligence support required? Several factors are important, but perhaps the most

important one is the “type of operation.” In today’s post-Cold War environment, an operation may range from war to one of the many environments covered by operations other than war (OOTW). Whatever the type or scale of the operation, it is almost certain to include some engineer requirements and, thus, a need for engineer intelligence.

Other significant contributing factors are the unit’s mission, the assets available to the engineer commander, and the threat. During the Cold War, the threat was clear and easily definable. Not so today. Besides a “typical” military threat (which still exists), the nature of the threat has changed over the past decade. Units today must not only contend with possible military opponents, but they are also frequently faced with the threats associated with the OOTW environment: insurgencies, internal civil disturbances, ethnic and religious tensions, humanitarian and disaster assistance, and terrorism. While these threats drive the need for intelligence requirements for all S2s, they pose some additional requirements for the engineer S2 because engineers have a critical role in performing a wide variety of stability and support operations.

To be successful, all S2s must be well acquainted with the Intelligence Preparation of the Battlefield (IPB) process, which is the cornerstone of fulfilling intelligence



The MDK-2 is a common combat engineer ditching system from the former Soviet Union. This vehicle, now being replaced by the MDK-3, is used to excavate full-width vehicle fighting positions and antitank ditches.

requirements. Most engineer officers are familiar with the IPB process, but they normally focus primarily on the terrain analysis portion (the first two steps). And with good reason: Who knows the terrain better than those who move it, shape it, and modify it? However, an S2 must apply all *four* steps of the IPB process:

1. Define the battlefield environment
2. Describe the battlefield effects
3. Evaluate the threat
4. Determine threat courses of action

In any type of unit or environment, an S2 must apply each step of the IPB process in as much or as little detail as required to support the commander and his mission. After these steps are integrated and applied to the situation, the S2 develops and produces some standard IPB products. These products include modified combined obstacle overlays, various enemy situation overlays, and weather analysis matrices.

The entire IPB process is taught during the Engineer Officers Advanced Course (EOAC) at Fort Leonard Wood. There, EOAC students receive training in IPB, intelligence and electronic warfare, and threat doctrine and tactics. During a culminating Warfighter III exercise, they are provided an opportunity to "play" the part of an S2 (see photo, page 27).

Providing appropriate intelligence support for diverse engineer missions and performing engineer-specific IPB is a challenge for both engineer and MI officers. Because the book solution often does not work, the S2 must tailor his intelligence support to align with the commander's needs, the unit's assets and capabilities, and the mission. In providing this support, the engineer S2 will prepare some additional IPB products that are especially germane to the engineer mission.

Performing an Engineer IPB

Engineer-specific IPB products are developed as the S2 anticipates the commander's needs. These products include bridging and fording site analyses and matrices, line of communication (LOC) overlays, hydrologic overlays, various obstacle lists and overlays, and lists of enemy engineer assets and capabilities.

Bridge and Fording Site Analysis. If the S2 is part of an engineer unit with a mission to perform bridging and fording operations, a thorough analysis of the rivers is required. LOC and hydrologic overlays are available for many regions of the world and can be obtained from the local topographic unit. These overlays, used in conjunction with 1:25,000- or 1:50,000-scale maps and friendly force maneuver graphics, assist the S2 conducting the analysis.

"Tunnel vision" has caused the downfall of many good S2s. While primary bridging and crossing sites must be identified, don't fixate on the obvious. Rivers are not the only areas that may require bridging. S2s must carefully analyze all the terrain for possible alternative routes as well as less obvious "waddies," ditches, or other gaps that may impede troop movement.

Bridging Matrix. Since the quantity of information acquired in a reconnaissance can get overwhelming, it is helpful to develop a bridging matrix. By listing all of the bridges along the main supply routes (MSRs) and alternate supply routes (ASRs) and their critical characteristics, the S2 develops a quick reference for each potential route. This matrix also facilitates analysis of the information, as shown in Table 1, page 29.

Lines of Communication Overlay. The LOC overlay

Table 1

Bridge Status Data: As of 200001 May 99 Main Supply Route Blanda							
Reference No.	Location	MLC	Width	Length	Bypass	Remarks	Status
1	FG 015 015	60	6	12	Impassable	PL Tin - PL Gold	Destroyed
2	FG 025 025	90	8	18	Easy	PL Tin - PL Gold	Unknown
3	FG 020 080	60	6	24	Difficult	PL Tin - PL Gold	Intact

shows the locations of bridges and fording sites and the known length, width, military load class, and bypass conditions of the bridges. By identifying the MSRs and ASRs that the maneuver units are most likely to use, the S2 can determine which bridges and fording sites may require engineer assistance to facilitate troop movement. Through the LOC overlay, the S2 provides the engineer commander and staff with a graphic picture of—

- Bridges designated *impassable* or *difficult bypass*.
- Bridge spans greater than the capability of the bridging assets currently designated for the area of operation.
- Destroyed bridges along specific LOC.

These factors can significantly impact the maneuver unit's mission and will drive the engineer commander's potential mission in supporting the maneuver unit.

Hydrologic Overlay. The LOC overlay showing the destroyed, impassable, and difficult bypass bridges is used in conjunction with the hydrologic overlay to assist the S2 in analyzing river characteristics. The hydrologic overlay provides information on a river's width, depth, velocity (meters per second), bottom composition, and bank slopes. It allows the S2 to recommend to the engineer commander potential sites for concentrating the unit's bridging and/or fording efforts. The initial map reconnaissance allows the unit to focus on a general area of bridging operations. Once tasked, the unit will conduct a ground reconnaissance to find suitable crossing sites.

Obstacle List Matrix. The S2 closely tracks the location and status of threat-emplaced mines, obstacle belts, and bridges prepped with demolitions or destroyed. As information regarding obstacles flows in from the battlefield, the S2 assigns a reference number to each of them. Breaking the

matrix into separate operation phases (for example, Phase Line Tin to Phase Line Gold), the S2 records the following information on the matrix (see Table 2):

- Obstacle location
- Obstacle type
- Date-time group discovered
- Source of information
- Obstacle dimensions
- Whether bypassed or cleared

Units must inform the engineer S2 when the status of an obstacle changes.

The S2 disseminates obstacle information to both engineer and maneuver units. At a minimum, the S2 disseminates the obstacle list matrix every 12 hours and when significant changes are reported. Obstacles also are posted on the engineer intelligence situation overlay, using the assigned reference number to assist with tracking them.

Engineer Intelligence Situation Overlay. The engineer S2 collects and analyzes the activities of threat engineer units and tracks the threat on the intelligence situation overlay. In addition to posting roads and bridges on this overlay, the S2 may also record such pertinent data as—

- Construction materials
- Water supply points
- Threat depots/dumps
- Airfield capabilities
- Threat minefields
- Barriers

Table 2

Obstacle List Matrix: As of 200001 May 99 Phase Line Tin - Phase Line Gold				
Reference No.	Location	Type	Date-Time Group/ Reported By	Remarks
1	FG 015 015	AP/AT minefield	190800 May/11th Cavalry	100 x 300 meters
2	FG 025 025	Blown bridge	190900 May/11th Cavalry	Easy bypass
3	FG 020 080	Road crater	190900 May/11th Cavalry	Breached

Table 3

Threat Engineer Assets						
Units	Obstacle - Clearing Vehicles	Mine Layers	Mine Plows	Dozers	Excavators	Bridging Assets
50th ID*	13	6	3			
5th Corps**		1	2	8	2	29
National***		3		19	4	61
50th ID Total	13	10	5	27	6	90
(*) 80 percent strength. (**) 80 percent strength with 30 percent allocation to 50th ID. (***) 100 percent strength with 20 percent allocation to 50th ID.						

- Pits and quarries
- Host nation engineer assets

To avoid overcrowding information, it may be necessary to prepare separate overlays. The overlays are disseminated to the engineer commander and the support unit's S2, G2, or J2, depending on the level and type of operation.

Templated Obstacle Overlay. When the situation warrants, the engineer S2 may develop a separate overlay showing suspected or possible threat-emplaced minefields and obstacles. A templated obstacle overlay helps the unit anticipate possible enemy courses of action and allows the commander to plan accordingly. It helps eliminate "surprise" enemy activities. However, posting templated obstacles with known, reported obstacles may lead to confusion and is not advised.

Threat Engineer Assets and Capabilities. A list of the specific capabilities of threat engineer assets opposing the supported maneuver units may be required. The list for each threat engineer unit includes equipment organic to it, such as minelayers, bridging assets, rafts, and trenching assets (see photos, pages 28 and 31). Numerous references, both classified and unclassified, provide information about engineer equipment capabilities. For example, the *Military Vehicles and Logistics* yearbook, published by Jane's Information Group, Inc., includes comprehensive descriptions of most engineer equipment used by armed forces around the world.

The S2 then develops a matrix showing the types and quantities of engineer equipment within each threat division, including assets estimated to be pushed down from higher echelons (Table 3). Finally, based on the threat strength, the S2 calculates the daily capabilities of threat assets and develops an estimate of the amount of mobility, countermobility, and survivability work that threat engineer units have completed, as well as how much additional work they may perform using these assets. The S2 provides an estimate of threat engineer capabilities to the engineer commander and should disseminate this matrix to applicable subordinate S2s.

Information gathered during the reconnaissance confirms or denies the templated data on the previously described overlays and matrices.

Automation and Engineer Intelligence

Various databases can track events on the battlefield and expedite the transfer of information between units if adequate signal support is available. Automated data-processing systems, such as the All-Source Analysis System-Warrior (ASAS-W), enhance intelligence capabilities significantly.

The ASAS-W is used to transfer database intelligence estimates, graphic and written intelligence summaries, Systeme Probatoire d'Observation de la Terre (SPOT) reports, and imagery products to like systems. Output from ASAS-W can be customized to help the S2 manage large quantities of information and analyze data.

Predeployment. Before deployment, engineer units should upload applicable digital topographic elevation data raster maps, databases, and operations graphics on their computer systems. The information uploaded is driven by the division or corps G2 analysis and control element and can be tailored to the unit's specific mission.

Customized Queries. Analysts use the ASAS-W to query by fields, such as time, unit, parent unit, and equipment. The key is knowing which fields to access. For example, queries for dozers or other engineer-specific equipment may be made from imagery intelligence (IMINT) databases. It is essential to know exactly how the information was input into the database since various nomenclatures, abbreviations, and terms may be used for similar equipment.

Operator Training. The downside to automation is the amount of training required to operate the systems. Once basic proficiency is reached, units must allocate time for soldiers to maintain their computer skills.

Presentation

After all information is collected and analyzed, the final step is to present the results. The S2 must clearly convey the information to the commander and his staff or his time and efforts were wasted. Matrices, slides,



The MTU-20 is one of several common tank-launched bridges from the former Soviet Union used to cross gaps less than 20 meters wide. Many are being modernized and offered for sale around the world.

and special products highlight critical data and help the S2 present information clearly. Often, however, there is insufficient time to produce the "perfect" product. The S2 must carefully weigh the impact each product will have on the section's resources (especially personnel) against its usefulness. If a presentation product takes time away from that needed to perform a required in-depth analysis (the basis of useful intelligence support), we recommend reducing the quality of the presentation product. Presenting the required information and analysis results is more important than presenting a "pretty" overlay or slide.

Conclusion

The engineer S2 must ensure that engineer intelligence needs are identified and integrated into all reconnaissance and collection plans, information requirements, and priority information requirements. Working closely with the S3, the engineer S2 also determines the data-collection activities that subordinate elements must perform, such as determining the status of MSRs, bridging capabilities, fording site reconnaissance, and confirming the types and locations of mines and obstacles. After data collection and analysis, the S2 tailors the IPB products and procedures described in this article to the unit's specific mission. Not all of the products pertain to every task or unit. Our intent is to present some options to help the engineer S2 provide the commander and his staff with intelligence information they can use to plan, fight, and win the battle.



Captain Glenister is Commander, I Corps Military Intelligence Support Element, Fort Lewis, Washington. Previous positions include S2, 555th Engineer Group, Fort Lewis; and Chief, All-Source Analysis and Production Section, 502d Military Intelligence Battalion. CPT Glenister holds a bachelor's degree from the University of Wisconsin.

Major Richerson serves as Chief, Office of Intelligence and Security, U.S. Army Engineer Center and Fort Leonard Wood. Previous assignments include S2 with the 4th Squadron, 7th Cavalry Regiment, Budingon, Germany; and brigade S2 with the 4th Combat Aviation Brigade, 3rd Armored Division, Hanau, Germany. MAJ Richerson holds a master's degree in strategic intelligence from the Joint Military Intelligence College, Bolling Air Force Base, Washington, D.C.

"Must have" references for the engineer S2:

- FM 34-130, *Intelligence Preparation of the Battlefield*
- FM 34-1, *Intelligence and Electronic Warfare Operations*
- FM 34-2, *Collection Management and Synchronization Planning*
- FM 5-114, *Engineer Operations Short of War*
- FM 5-100, *Engineer Operations*

German Engineer Officer Advanced Course

By First Lieutenant Brinton H. Rosenberry

How would you feel if you were the first—the test pilot or the guinea pig? For example, would you be intimidated or apprehensive if the U.S. Army asked you to attend and evaluate a school of an allied nation whose language you haven't spoken for some time?

When asked to attend the German Engineer Officer Advanced Course (GEOAC), or *Pionierkompaniecheflehrgang*, I felt those emotions. But I accepted the challenge, and it was an opportunity I will never forget. The GEOAC is a month-long course designed to hone experienced lieutenants and captains for company command. The 22 course participants include an officer from five allied countries—France, Argentina, Poland, Uganda, and the United States. The

course is taught entirely in German, so only officers with above average listening and speaking skills in the German language (particularly concerning military terminology) should consider attending.

The billets, classrooms, lecture halls, physical-fitness facility, and Officer's Mess are in Prinz Eugen Kaserne, Munich; however, terrain walks, defensive and offensive practical exercises, and outings are conducted throughout Germany. Subjects (in order of emphasis) include mechanized tactics, logistics, military justice, supply, maintenance, environmental issues, career management, and projected force and equipment modifications. Leadership techniques and experiences are discussed throughout the course.

The course dates were 2 - 26 July 1996, so I arrived on 27 June to settle in—verify my syllabus, conduct an area and transportation reconnaissance, and ensure that I had the necessary equipment (I didn't). The course coordinator (*Hoersaalleiter*)—the equivalent of a U.S. Army lieutenant colonel—and the course operations sergeant (*Hoersaalfeldwebel*)—the equivalent of our staff sergeant—discussed course objectives and German military and civilian customs and courtesies. I was impressed by their professional, yet extremely friendly, demeanor. They assured me that I would not be excluded from anything.

I made a conscious effort to speak German, even when addressed in English. Some of the allied students spoke German as a second language. Others had studied German in school and knew about their GEOAC assignment far enough in advance to complete refresher training. I believe that refresher language training should be mandatory for everyone attending the course. As a visitor to an allied country, it is a courtesy to have a good grasp of the language. No one wants to be like that foreign student we've all known—the one who sits in class, smiles a lot, and nods "yes" to every question.

I was billeted in a single-occupancy room furnished with chairs, wall lockers, a desk, a bed, a sink, and a mirrored medicine cabinet. There is one community shower and latrine per floor. There are no females in the engineer branch of the German Army, so there are no accommodations for females. The only military occupational specialty or branch offered to females is medical related.



Students from GEOAC rest after climbing Brannenbergs highest mountain peak. Class terrain walks were conducted throughout Germany.



Class photo of the 1996 GEOAC participants.

Visiting officers ate in a private room in the Soldiers' Mess, although the menu was the same for everyone. The cost for daily meals was very low; however, I ate most dinners and weekend meals in the Officers' Mess (*Offizierheim* or OHG) or on the economy. The Offizierheim prices reflect the actual cost of the food and labor for preparation, so the price is at least 50 percent less than at off-post establishments.

The breadth of the course was on target, but the depth of study was seriously limited by time. We adhered strictly to the well-planned syllabus due to the compact nature of the course. The class was divided into five groups and students remained in these groups for the entire course. For a group to be successful, camaraderie and class participation were necessary. I was expected to answer questions and follow the flow of information just like every other student. Out-of-class projects were no exception.

My air-assault knowledge was of particular interest because there are very few airborne units and no air-assault units in the German Army. The course coordinator was an outstanding facilitator who sparked discussions involving personal experiences, ideas,

and techniques. He often asked "Why do you do that?"

We spent many evenings socializing and attending piano and band "*Biergarten*" concerts. The curriculum also included day trips to historic and architectural sites, white-water rafting, and a weekend of mountaineering. Formal physical training was conducted three times a week and ranged from indoor soccer to water polo to weight training. The facilities were excellent. Each evening I ran with the French officer and a German officer.

I am extremely appreciative of the staff of ENTEC (Euro Training Engineer Center) for their support. The deputy commandant of this NATO warfare school (supported by Great Britain, Germany, Belgium, France, Australia, and Canada) and two of its sergeants are the only U.S. soldiers stationed in Munich. They supplied the military equipment I needed and introduced me to the instructors and school translator at ENTEC. These three soldiers were always willing to lend a hand and were available when I wanted to speak or hear English.

The GEOAC was an outstanding opportunity for me. The experience of assembling, talking, and comparing notes with six different NATO forces

was like no other—especially at the mission-execution level. My eyes were opened to entirely different systems of troop acquisition and training, equipment, governmental controls, and military customs that support the same end state—defense of a nation.

The GEOAC does not replace the U.S. Army Engineer Officer Advanced Course but is an excellent addition to it. An understanding of our allies' capabilities and tactics (and vice versa) can only enhance an existing, solid, multinational relationship.

Probably most reassuring for me was that I found engineer officers—regardless of nationality—to be quite similar. They are mentally and physically tough leaders whose intellect and flexibility are unmatched both on and off the battlefield. If you are offered an opportunity to attend the German Engineer Officer Advanced Course, I encourage you to accept. It is an extremely rewarding experience.



First Lieutenant Rosenberg is currently the executive officer of B Company, 326th Engineer Battalion (Air Assault), Fort Campbell, Kentucky. He received German language training at the Defense Language Institute, Monterey, California.



ENGINEER UPDATE

Commercial numbers are (573) 563-xxxx and Defense System Network (DSN) numbers are 676-xxxx unless otherwise noted.

Department of Training and Doctrine Development (DDD)

ENFORCE XXI-97. The theme for this year's conference is "Engineers—Shaping the 21st Century Battlespace." Scheduled for the week of 29 April through 2 May, the conference will include presentations by LTG Joe Ballard, the Chief of Engineers, and EXFOR and corps commanders. Numerous breakout sessions, virtual and tactical demonstrations, and dynamic displays will complement the agenda. Registration information will be mailed in March. POC is CPT Mark Maciel, -4038.

Paper or Plastic? We need your input! As budgets shrink, we are exploring alternative ways of disseminating *Engineer*, with a goal of reducing or eliminating paper copies. We will continue to provide a forum for two-way communication with military and civilian engineers throughout the Army and our sister services as best we can. Possible alternatives include Internet and disc-copy distribution only. How would the lack of paper magazines affect you and your unit's mission? Request vignettes documenting the relevancy of *Engineer* to your jobs and careers as well as your requirement for paper versus electronic distribution. Include specific ways you use the magazine and topics most beneficial to you. Service to our customers remains our primary concern. Mail comments to: Commandant, U.S. Army Engineer School, ATTN: ATSE-TD-D-EB, Fort Leonard Wood, MO 65473-6650. The e-mail address is: eubanksc@wood-vines.army.mil. POC is Cathy Eubanks, -4104.

Doctrine Products. The Engineer School is transitioning to electronic distribution of draft doctrine publications. In the near future, you will receive draft products for review via disc or electronic mail. Microsoft Office will be the platform used to produce draft publications. Reviewers should continue to use DA Form 2028 to record recommended changes. Units are asked to review their e-mail addresses in the Engineer Unit Directory for accuracy. Send changes via e-mail to: bakern@wood-vines.army.mil.

As another cost-cutting measure, we have drastically reduced distribution address lists. We will continue to publish in *Engineer* information on draft publications currently staffed for review. If you do not receive a particular publication and would like to, call Lucius Warrick, -4115.

Draft Publications. The initial draft of FM 5-250, *Explosives and Demolitions*, is being distributed via paper and electronic media. This draft publication combines the current FM 5-250 and TC 5-250, *Demolition Effects Simulators*, as well as information on the modernized demolition initiators. The suspense for field comments is 15 May 1997.

Drafts of FM 5-170, *Engineer Reconnaissance*, and FM 5-34, *Engineer Field Data*, are scheduled for distribution about 1 April. POC is Lucius Warrick, -4115.

CMF 12 Basic Noncommissioned Officer Course (BNCOC).

TRADOC approved consolidation of the separate 12B and 12F BNCOCs on 17 July 1996. The new 9-week course includes those tasks identified as critical for the 12B squad leader. A new program of instruction (POI) based on TRADOC Regulation 350-70 and Training Support Packages (TSP) are being developed in the Total Army Training System (TATS) format. Trials will be conducted at Fort Leonard Wood and a Total Army School System engineer battalion during FY97. Once validated, this course will be instructed using one POI for both Active and Reserve Component soldiers.

The consolidated course increases the class length from 7 weeks and 4 days for 12B BNCOC and 7 weeks for 12F BNCOC to a single 9-week course. Content includes:

Training	Hours
Demolitions	44.5
Reconnaissance	28.0
Mine Warfare	38.0
Combat Construction	33.6
Field Training Exercise	72.0
Call For/Adjust Fire	16.0

In addition to the above technical tasks, the POI includes 85 hours of common leader training required by the U.S. Sergeants Major Academy.

Effective 1 October 1996, only promotable sergeants are permitted to attend. Nonpromotable sergeants who report for training will be returned to their units at the unit's expense.

Class dates scheduled at Fort Leonard Wood for FY97 are: 6 January through 11 March, 17 March through 16 May, 22 May through 25 August, and 1 August through 3 October. POC is MSG Lawrence Marks, -4125.

Total Army School System (TASS). The TASS Division will conduct preaccreditation visits during FY97 to all seven regions in conjunction with active and inactive duty training. Validation of the 12B, 12C, and 12Z courses at Camp Grafton, South Dakota, is scheduled for April-July. Contracts are underway for the 51B/H and 62E/N

Department of Tactics, Leadership, and Engineering (DTLE)

courseware, with completion scheduled for December. Classes for the Reserve Component Configured Courseware (RC3) will be updated before the end of April. Course information, instructor certification, and accreditation will be briefed 1 May during the ENFORCE Conference. POC is MAJ Sue Myers, -4106.

New Director. We welcomed LTC James Koch, our new director, in December 1996. He previously served as Commander, 536th Engineer Combat Battalion (Heavy), in Panama. LTC Koch may be reached at -4119.

Organization Changes. Beginning 3 March 1997, the Leadership, Combined Arms, and Combat Engineer Branches of DTLE are consolidated into the Common Leader Training Division. This move replaces the Tactics Division and is a precursor to the FY99 reorganization proposed for the Maneuver Support Center. The current Environmental Branch will mature into an Environmental Division. POC is Penny Moats, -4119.

Engineer Officer Basic Course (EOBC). Before leaving the commissioning source to attend EOBC, students should receive a welcome packet that contains information critical for a smooth transition to the school. Students who do not receive a mailed copy can access the packet on the Internet at [<http://155.9.32.3/EOBC/main.htm>]. POC is CPT Donald Petrich, Jr., (573) 596-0793.

Engineer Officer Advanced Course (EOAC). We are revising officer training programs to meet TRADOC-mandated time constraints. Request your suggested improvements to the EOAC course content now to include in a revised program of instruction. The new EOAC, scheduled to begin 1 October 1998, will have 18 weeks of course work at Fort Leonard Wood. It will be immediately followed by 6 weeks of course work at the Combined Arms Service Staff School (CAS3) at Fort Leavenworth. POC is MAJ Darren Naumann, -4130.

Countermine Training Support Center (CTSC). Created in 1996, the CTSC provides training and information on demining, countermine, booby traps, and unexploded ordnance to U.S. military forces. CTSC personnel also monitor the use of mines by U.S. and foreign countries and extract mine data from multiple sources, including tactics, techniques, and procedures. A recently approved Humanitarian Demining Operations cell will begin operations this summer. It will have a mobile training team to support units in the field and eventually will supply training aides. To request support for your unit, call MAJ John Smale, -4134, or Greg Bier, (573) 596-0131, ext. 3-5518.



BRIDGE THE GAP

By Command Sergeant Major Julius B. Nutter
U.S. Army Engineer School

Be Ethical!

What each member of the Engineer Regiment does in the next year is critically important to the nation, the Army, and the press. In a time of instant global news coverage, the actions of individual soldiers and the decisions made by military leaders often take on strategic importance. Army ethics and our nation's expectation that soldiers must adhere to strict ethical standards will become increasingly important as we move into the information age.

Ethics are the principles of "right" or good conduct. They are the rules and standards, including moral principles and values, that govern the conduct of the members of a profession. Ethical issues abound in our complex society, and we are called upon daily to make decisions in which the right or good choice is not always obvious or easy to perceive.

Why does the Army have policies and establish procedures on ethics? Isn't just plain, old-fashioned honesty in practice anymore? I regret to say that the answer is "No"—and it hasn't been in practice universally for quite some time. As James Callaghan, British Prime Minister, stated in a speech in 1976, "A lie can be half-way round the world before the truth has got its boots on."

But besides an inner code of morality, there's a bottom-line reason for Army ethics. In the experience of most leaders who voice their experience to others, unethical behavior sparks a failure mode that

runs throughout an entire organization. Given enough time, it runs all the way to the bottom line.

In our lifetime, we have drifted to some fuzzy thinking where ethics are concerned. The philosophy of some political officials in our country today seems to be, "Do whatever you have to, just don't tell me about it." With this message, these leaders have removed themselves from responsibility should the questionable conduct be discovered. This is bury-your-head-in-the-sand or wastebasket leadership.

The U.S. Army does not want soldiers to have their heads in the sand or the wastebasket. We ask that soldiers make individual decisions involving ethical matters based on general policies. When a soldier is in a situation that he or she feels needs clarification, he should ask. Don't keep quiet. What we as an institution don't know will hurt us eventually.

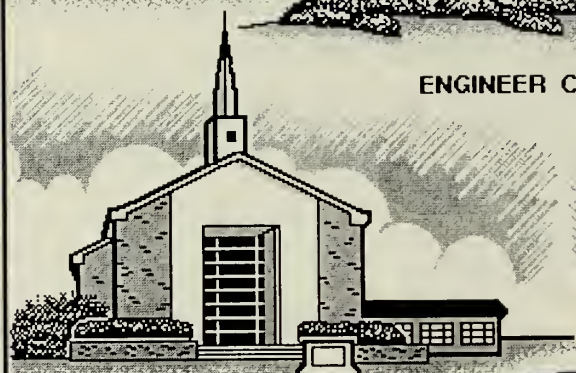
The Army has written policies that dictate ethical behavior. Their intent, for the Army as a whole, is that ethical behavior will be the norm. But each individual soldier writes the final line on ethics in the Army. In the general public's eye, soldiers are the Army's credentials.

In short, the Engineer Regiment does not want you to bend the rules; we want you to embrace them. Mark Twain once said, "Always do right. This will gratify some people and astonish the rest."¹ Either way, we win.

¹ Speech, Greenpoint Presbyterian Church, 1901.



ENGINEER CENTER



SOLDIER MEMORIAL CHAPEL



ROLLING HEATH
SCHOOLHOUSE
1912



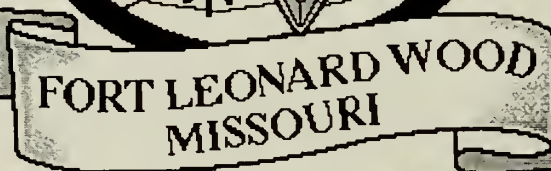
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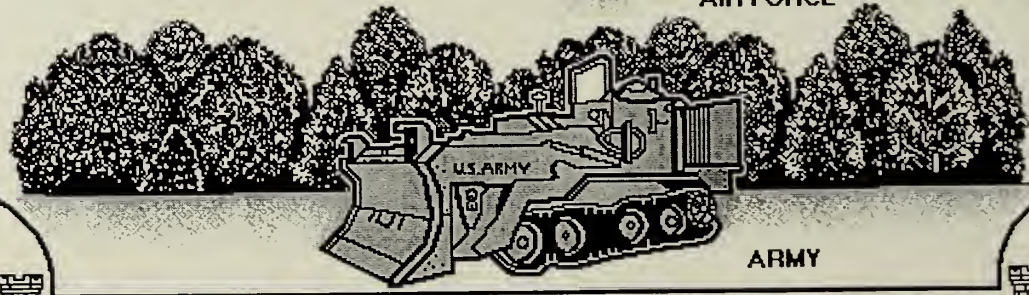
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April 1997

FORCE

XXI





CLEAR THE WAY

By Major General Clair F. Gill
Commandant, U.S. Army Engineer School

These are exciting times for our Army and our Engineer Regiment. I recently was privileged to spend a few days in the Mojave Desert at the National Training Center (NTC) with our engineers of the Experimental Force (EXFOR). They were helping to create history through their participation in the Army's digital experiment.

Let me tell you how magnificent those soldiers of the 299th Engineer Battalion, 4th Infantry Division, are. They have spent almost a year in reorganizing themselves; equipping their vehicles; and training, training, training to get ready to prove or disprove the functionality of adding digital technologies to our systems and tactics, techniques, and procedures. We provided as much support as we could from the schoolhouse (often via TNET—satellite-based training), and there was enormous support at Fort Hood from waves of contractors and a powerful EXFOR Coordination Cell. Many others contributed from across the Engineer Regiment. Our Corps laboratories provided functionality and equipment; and the 29th Engineer Battalion "loaned" a detachment of four topographic soldiers to operate our most modern Digital Topographic Support System (DTSS) and demonstrate its potential utility to the brigade combat team. But the real work was done by the soldiers and their leaders on the ground.

What I witnessed on the ground at the NTC was a true revolution in situation awareness. Leaders *know* where their soldiers are on the battlefield without having to fight through often broken communications links. Small units and equipment teams can be directed and moved efficiently and semi-independently across the battlefield to new work sites, with high assurance that they will get to the right spot—under battlefield conditions. Work progress reports can be made timely and posted automatically to higher headquarters. Obstacles can be located and confirmed, and their locations and conditions posted in moments to all units with a need to know. (This capability does not work as well as we want it to yet, but the potential is clearly there.) DTSS offers great promise: Engineers can provide extremely valuable terrain-visualization tools to

the maneuver commander and his planners to vastly increase their ability to "see" the battlefield and reduce risks to the force. Future battles fought over terrain not as well mapped or digitized as Fort Irwin may have to rely heavily on the terrain team's capability to customize and download terrain data from the National Imagery and Mapping Agency and many other sources.

As grand as this Army experiment was, I left with another major conclusion—that we engineers must still master our basic tactical skills to a high degree of efficiency and rehearse them with our maneuver brethren at every level. Continuous operations, such as those envisioned in the future, allow little room for error. We must do our important work correctly the first time. We continue to have difficulty siting obstacles properly so they fit with the commander's intent. Much of this problem is due to a lack of engineer training of/with the maneuver leaders.

To address this and similar problems, it is critical that the maneuver commander and his engineer develop and maintain a powerful command relationship. The engineer must be on the maneuver team, building bonds of trust and able to sense where the combined arms team will fight its next battle. I am utterly convinced that our present ERI (engineer restructure initiative) alignment is critical to success. In this alignment, the engineer battalion commander and staff support the maneuver brigade, and the engineer company commander is part of the maneuver task force. Digitization adds to our efficiency, but it cannot resolve the relationship imperative.

I'm sold on what I saw in the desert—digitization is the wave of the future, and we will embrace it across the Corps of Engineers. Many engineer units will not be as well equipped as our ERI combat engineers were in this experiment for years to come, but we all must start thinking "out of the box" to find better ways of adapting the wonders of modern technology. The physics of this earth are not likely to change soon, and we continue to struggle with overcoming natural forces. But, we can learn how to do things smarter and more efficiently by embracing change and adapting to it. Our motto is right on target—Essayons.

Engineer

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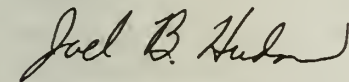
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Front Cover: Drawing of Fort Leonard Wood's schoolhouse and engineer assets, by Jeanni Wilson.

Back Cover: Two American soldiers look down on a long row of "dragon's teeth" concrete devices installed to halt invading tanks at the Siegfried Line. American troops moved through a break in the vaunted defense line and passed into Germany in September 1944.

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The Fulcrum for the Full-Spectrum Force: The Engineer Regiment

By Colonel Philip F. Federle and Lieutenant Colonel Robert S. Kirsch

This article briefly traces the past two ENFORCE conferences, where we defined the regimental vision and a unified regimental theme. It also highlights the release of the Army and Joint Vision 2010 blueprints, which describe the future roles and views of the Army and respective services. To date, the Engineer Regiment's role and contributions have not been articulated in many of the key documents that define the future force (e.g., TRADOC Pamphlet 525-5, *Army Vision 2010*, and *Joint Vision 2010*). These documents do not address the roles of engineers, per se. Instead, they infer that engineers are part of logistics operations. This inference is unacceptable. To secure our place as a relevant member of the land component of the joint warfighting team, we engineer leaders must forge a strategy that will harness the collective and collaborative strengths of our regiment to shape the battlespace of engineer opportunities. We must build and sustain a campaign to ensure that engineer capabilities are considered in the future development of force structures, doctrine, materiel requirements, research and development, and training. In this way, we will preserve the traditions of the regiment that effectively enable the Army to execute its role in our nation's strategy and achieve full-spectrum dominance in the 21st century.

To many people, the word *fulcrum* conjures up the mental image of a playground teeter-totter and the physical relationship of a point of support on which a lever turns in raising or moving something. In this article, the word *fulcrum* is used to mean an entity that supplies the capability for action. Ideally, our Engineer Regiment will be modernized and knowledge-based—a conventional and digitized force with the ability to conduct the full range of engineer operations promptly and to enhance the Army's ability to execute land warfare and serve our nation throughout the entire spectrum of crises.

The Road Traveled

In 1995, Major General Joe Ballard, the Engineer School commandant, focused the purpose of the Senior Engineer Leader Training Conference (SELTC) toward preparing the regiment to meet 21st century Army requirements. Accordingly, he renamed the conference *ENFORCE XXI*. This conference focused on the initial concepts, composition, characteristics, and roles of the Engineer Regiment as a key enabler, or *fulcrum*, of the Army's vision for Force XXI. A cornerstone was set with the publication of the pamphlet *Engineer 2010*, which started the regiment down the road of change and modernization. It provided a new construct to describe engineer missions:

- **Portray Terrain to the Force.** Provide the terrain picture (terrain visualization) for battle command and mission planning and rehearsal, tie video-mapped images to actual ground, and update the terrain picture in real time.
- **Allow the Force to Go Where It Wills.** Build an entry base in any environment, find or build routes through any terrain, eliminate obstacles to free maneuver, break into defensive structures, and fight through defended terrain.
- **Allow the Force to Fight Where It Wills.** Build fighting and support positions, hide and protect the force, convert existing structures for support and defense, and occupy and fight defensive positions.
- **Wield Terrain as a Weapon Against the Enemy.** Employ obstacles before and during battle to attack and frustrate the enemy, fight lethal ground, and disguise terrain reality—confuse the enemy and unhinge his plan.

ENFORCE XXI energized the process of change and initiated how engineers must view their roles and missions within Force XXI.

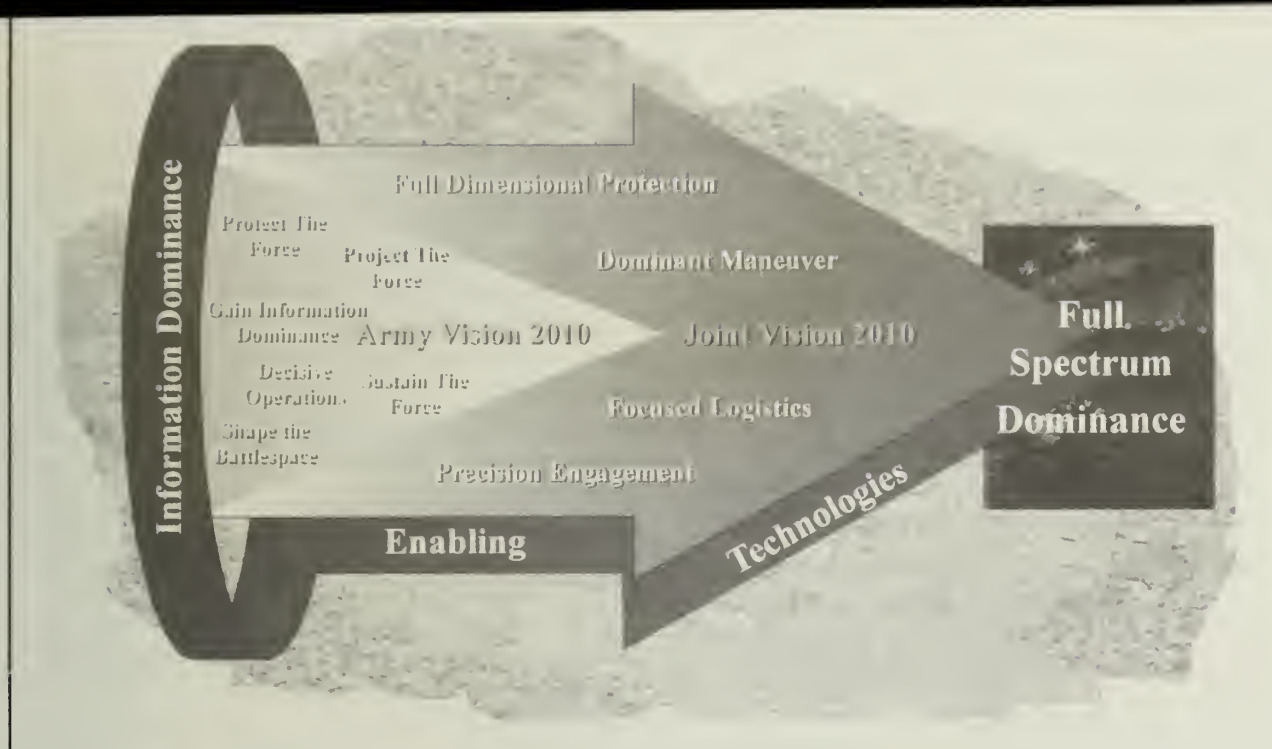


Figure 1

In early 1996, a newly revised FM 5-100 was published. It significantly expanded the doctrinal focus of the engineer force and described the full capabilities of every component and segment of the Engineer Regiment.

During ENFORCE XXI-96, the senior engineer leadership reflected on the question of relevancy of the Corps of Engineers and whether our regiment can remain relevant to the Army as it transitions to Force XXI. Major General Clair Gill, the current Engineer School commandant, challenged the senior leadership to get involved. Regimental leaders must contribute to the modernization process and maintain the engineer vision. More importantly, each leader must become a high-impact regimental team player. We must demonstrate confidence and competence, aggressively portray the Corps' capabilities to supported commanders and customers, and be there to deliver on our promises.

The term "unified regiment" was coined during the 1996 conference. Generals Genetti and Anderson noted that, as the force continues to draw down, it is absolutely critical to get every element of the engineer family into the fight to win tomorrow's victories. Each member of the regiment brings unique capabilities that can be applied throughout the spectrum of crises. The Engineer Regiment must unify into a cohesive team that includes USACE divisions, districts, laboratories, and the Directors of Public Works; troops and units of the Active and Reserve Components; and Department of the Army civilians and civilian contractors.

Joint and Army Visions 2010

Joint Vision 2010 (JV 2010) set the baseline and provides a coherent view of the future (Figure 1). Implications for joint operations are expressed in the

following terms of emerging operational concepts:

- **Dominant Maneuver.** Multidimensional application of information, engagement, and mobility capabilities to position and employ widely dispersed joint air, land, sea, and space forces to accomplish assigned operational tasks.
- **Precision Engagement.** System of systems that enables joint forces to locate the objective or target, provide responsive command and control, generate the desired effect, assess the level of success, and retain the flexibility to re-engage with precision when required.
- **Focused Logistics.** The fusion of information, logistics, and transportation technologies to provide rapid crisis response; track and shift assets, even while en route; and deliver tailored logistics packages and sustainment directly to the strategic, operational, and tactical levels of operations.
- **Full Dimensional Protection.** The control of the battlespace to ensure that our forces can maintain freedom of action while providing multilayered defenses for our forces and facilities. All components of the joint force must evolve concepts and technologies that can be easily coordinated and synchronized.

In October 1996, the Army Chief of Staff, General Dennis Reimer, released Army Vision 2010 (AV 2010). This document is the blueprint for the Army's contributions to JV 2010, and it reinforces the relevancy of the Army in the 21st century. Army elements will execute their responsibilities as the land-force component of the joint force through a deliberate set of patterns of operations. These patterns of

operations are neither phases nor sequential. They serve to focus the many tasks armies perform in war or other military operations. The patterns of operations follow, with their engineer-enabling technologies shown in parentheses:

- **Project the Force.** (Automated laser sensors and the global positioning system for precise construction; information-based construction techniques; light-weight, high-strength construction materials; and automated construction management.)
- **Protect the Force.** (Construct defenses with fortifications, protective structures, obstacles, and dams and levies.)
- **Shape the Battlespace.** (Terrain visualization, split-based operations, stand-off minefield detection systems, robotics, digitized assault bridging and breaching, tele-engineering, and environmental stewardship.)
- **Decisive Operations.** (Artificial intelligence and sensors for mine avoidance and detection, intelligent munitions, and natural disaster relief.)
- **Sustain the Force.** (Accurate infrastructure maintenance predictions and robotics applied to precision construction tasks.)
- **Gain Information Dominance.** (Split-based terrain visualization operations, tele-engineering, and cyber-engineering.)

General Reimer's goal in executing AV 2010 is to create evolutionary changes that will achieve revolutionary results. His aim is to create an Army that possesses the capabilities to operate across the full spectrum of conflict—an Army that can accomplish the range of missions predicted to be most prevalent during the early decades of the 21st century. The range of missions in AV 2010 are organized in seven general areas:

- **Defending or Liberating Territory.** Major regional contingencies and lesser regional contingencies.
- **Punitive Intrusion.** Counterdrug and counterterrorism.
- **Conflict Containment.** Military operations other than war.
- **Leveraging Technology.** Space applications; command, control, communications, computers, and intelligence; systems integration; and battlefield awareness.
- **Reassurance.** Forward presence.
- **Core Security.** Counterdrug, illegal immigration, and crime in the streets.
- **Humanitarian Operations.** Disaster relief, population evacuation, and refugee protection.

The U.S. military will be tasked to respond to numerous crises in the years ahead. Although the magnitude and frequency of crises are unpredictable, it is certain that the

full spectrum of Army (and engineer) capabilities will be required to support each of these general mission areas. Engineers will have a key enabling role in the successful accomplishment of each mission.

In answering his own question—"Why an Army?"—General Reimer stated that conflict and instability are now land-centered (there are no competitors for the skies or seas). Land-centered conflict is people-focused. The ability to decisively control the land, populations, and valuable resources is essential to the resolution of conflict and depends on boots on the ground. Army engineers must be relevant, critical, and full participants in achieving Army objectives to resolve land-centered conflicts and instability.

Implications for the Engineer Regiment

Just as JV 2010 provided the benchmark for AV 2010, AV 2010 provides a definitive azimuth for senior engineer leaders to set our course to 2010 and beyond. AV 2010 orients the Engineer Regiment to address, in an Engineer Force XXI strategy, the doctrine, training, leader development, organization, and materiel required to successfully accomplish land-force operations in the 21st century. This action is critical! Significant effort and commitment by our senior engineer leadership are required to apply the time, patience, and discipline needed to develop, fund, and manage this strategy (Figure 2, page 5).

We have built a good foundation during the past two ENFORCE conferences. We developed an inspiring vision that identifies where we, as a regiment, want to go. We began the task of building our team and unifying the regiment. The Engineer Regiment represents a rich repository of capabilities that are the essential enablers for the decisive success of the force across the spectrum of conflict. Our regiment is integrated across the heavy, light, special operations, and technical segments of the Army, and it is comfortable with joint, multinational, and nongovernment partnering. The engineer force is versatile and can respond on short notice to support the full spectrum of military operations. We demonstrate every day that we are relevant, although we have yet to be fully recognized in the Army's key documents or funding stream for change and modernization with Force XXI strategies.

The Way Ahead

It is time to develop an Engineer Force XXI strategy that will encapsulate and articulate the engineer requirements necessary to enhance, enable, and contribute to AV 2010 and JV 2010 goals. Senior engineer leaders must develop an overarching strategy that will be proactive, relevant, and prescriptive in meeting the needs of the future.

Concept for Development of Engineer Force XXI

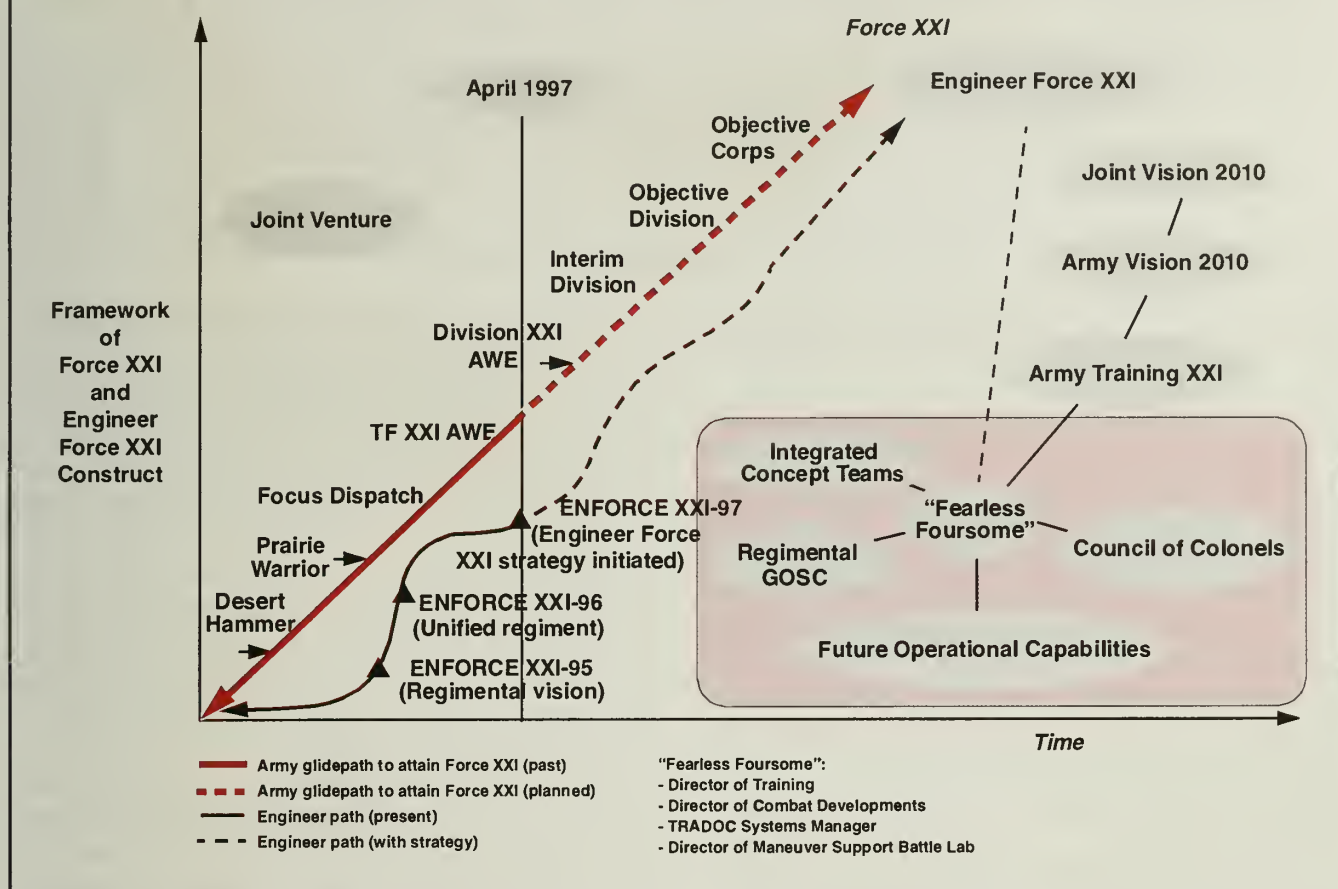


Figure 2. The lack of a comprehensive engineer strategy has resulted in a meandering and reactive response to Force XXI requirements. A collaborative effort is required to develop a relevant and proactive strategy for the Engineer Regiment that complements and parallels the Army's lead.

Just as TRADOC is the architect for the Army's future, the Engineer School, as the engineer proponent, will lead the effort to develop the "Engineer Force XXI Strategic Plan." Guided by the commandant, the "Fearless Foursome" (the Directors of Combat Developments, Training, and Maneuver Support Battle Lab, and the TRADOC Systems Manager) will be the central core of the team. Other mechanisms exist to support this effort. They include the Council of Colonels, the Regimental General Officer Steering Committee (GOSC), and the requirements determination process (see "A New Way of Doing Business," page 24, *Engineer*, March 1997). A key piece of the strategy is to develop a construct to cross-walk engineer requirement solution sets to the Army's patterns of operations. Engineer solutions to concepts, enablers, and/or technologies that support patterns of operations further enhance the regiment's relevance and assist in securing the requisite resources to modernize our regiment.

At ENFORCE XXI-97 we will continue to build our team and frame the outline of the Engineer Force XXI strategic plan. The Engineer Regiment is as relevant today as at any time in our 200-year history. We will remain relevant,

contribute as a key combat multiplier, and be responsive to our nation's needs. Engineers are the *fulcrum* to effect the guidance and aims in JV 2010 and AV 2010. We have the expertise, organization, and equipment to fulfill General Ballard's and General Gill's visions for an Engineer Force XXI strategy. We've been told how wide, how deep, and in what direction — now we have to start digging!



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Lieutenant Colonel Robert S. Kirsch serves as Director, Department of Training and Doctrine Development, U.S. Army Engineer School. He previously served as Commander, 554th Engineer Battalion and executive officer, Office of the Chief of Staff, U.S. Army Engineer Center, Fort Leonard Wood. LTC Kirsch holds a master's degree from The Ohio State University.

The Unified Regiment— A Progress Report

By Brigadier General Phillip R. Anderson and Brigadier General Anders B. Aadland

The *One Corps, One Regiment, One Fight* concept is about one year old. Introduced at ENFORCE XXI-96, the concept of a unified regiment electrified the Army engineer community. As participants listened, the light slowly dawned that we have a great opportunity to touch the future. The concept described the vision of our regiment as a cohesive force, part of a shrinking Army in transition, and compelled to change some "old ways" that are no longer relevant. However, the implied issue, the one that hit the center of our collective souls, was commitment among the components of the Engineer Regiment to mend the schisms that have crept into our relationships and to work as a team, transcending the "warrior" and "civil" associations that have so deeply branded each camp. We rearticulated our bonds and pledged to set our house in order collectively. It was a great week!

The enormity of coming to resolution with the concept became apparent quickly. There was far too much at stake to let the expectations wither and die. One manifestation of those expectations was that the term *One Corps, One Regiment, One Fight* was cropping up everywhere (sometimes cited as *One Corps, One Regiment, One Team*). Words are nothing without actions and the concept was a call to action. We engineers quickly identified the key axes:

- Delineate "ownership" of functional responsibilities.
- Expand participation in the doctrine-development process.

- Develop a self-sustaining mechanism to keep our training relevant and effective.
- Inspire the regiment by promoting common values and understandings.
- Demonstrate to the Army and the nation that the Corps of Engineers can speak, work, and develop as a single team.

Working on the future is tough when you are fully committed with problems in the present. We realized that we had to maintain a high level of progress toward meeting the expectations created at ENFORCE XXI-96. It's now obvious that achieving full closure will take more than a year. So, it's time for an in-progress review!

The first step of our action plan was to establish a senior oversight committee—a Unified Engineer Regiment General Officer Steering Committee (GOSC). Figure 1 shows the GOSC charter and members. The committee first met at Fort Belvoir in July 1996, then again in November 1996 and in March 1997. The GOSC decided to appoint Process Action Teams (PATs) with appropriate subject matter experts to address specific issues and develop solution sets. Major General Albert J. Genetti Jr. noted that the Engineer Regiment has the perfect tool in this GOSC process to resolve several key responsibilities in preparation for the Quadrennial Defense Review (QDR). Both a QDR process briefing and a unified regiment update briefing will be presented during ENFORCE XXI-97.

General Officer Steering Committee	
Charter: to take optimum advantage of the synergistic and complementary relationships among all parts of the unified Engineer Regiment	
Members	
■ Director of Military Programs, USACE	■ Deputy Chief of Staff for Engineers, USAREUR
■ Assistant Commandant, USAES	■ Chief, Research and Development, USACE
■ Assistant Deputy Chief of Staff for Combat Developments, TRADOC	■ Chief, Public Works, USACE
■ Assistant Chief of Engineers, Reserve Affairs	■ Honorary Colonel of the Regiment

Figure 1

Functional Responsibilities Process Action Team	
Charter: to make significant improvements in the manner in which the unified Engineer Regiment develops organizations and doctrine	
Members	
■ Deputy Commander, 412th Engineer Command	■ Commander, Waterways Experiment Station
■ Director of Combat Developments, USAES	■ Director, Office of the Chief of Engineers (Pentagon)
■ Director of Training, USAES	■ Director, Engineer Strategic Studies Center
■ FORSCOM Engineer	■ Chief of Staff, USAES

Figure 2

By the third meeting of the GOSC (on 24 March 1997), the requirements for background information had been established, and the members moved directly into substantive debate on major issues. Much of the discussion concerned preparation for the update presentation during ENFORCE-97. The GOSC made major changes to the draft script. It wanted more emphasis on future initiatives to strengthen cooperation among constituent parts of the regiment. The title "Topographer of the Army" was among the "bump-up" issues that received lively debate. The GOSC was concerned about the "looseness" of the boundaries of duties associated with the title as well as the somewhat anachronistic-sounding name itself. The GOSC also wanted more specifics concerning potential DOD-level disagreements over Engineer School humanitarian demining initiatives.

Communicating the *One Corps, One Regiment, One Fight* story is critical to achieving our goal of a truly unified regiment. Toward that end, action officers at the U.S. Army Engineer School's Directorate of Combat Developments and the U.S. Army Corps of Engineers' Engineer Strategic Studies Center created a Unified Regiment home page on the Internet. This home page includes a summary of the original *One Corps, One Regiment, One Fight* briefing. About 300 "guests" view the page monthly. You can locate it on the Fort Leonard Wood home page at <http://www.wood.army.mil/DCD/Regiment/regiment.htm>.

Figure 2 shows the first and most challenging PAT chartered by the GOSC. The Functional Responsibilities PAT recognized that no other branch of the Army has such a dual mission as does the Engineer Regiment. The regiment keeps itself trained and equipped to respond to worldwide military challenges during Army, joint, and combined operations. Engineers are also responsible to the president and Congress for many civil engineering functions that directly contribute to our national well-being and that of our friends.

The actual work of the PAT was to—

- Collect, rate, and synthesize positions and policies on functions and issues across the Engineer Regiment.
- Develop an action plan for assigning or migrating functional responsibilities.

- Recommend actions to the Unified Engineer Regiment GOSC.

Specific tasks of the Functional Responsibilities PAT were to—

- Set up common frames of reference for those engineering functional responsibilities that are subtasks for military contingency and stability and support operations. Determine which elements have the lead and which have support responsibilities for specific functional areas.
- Identify specific responsibilities for the functional areas in order to coordinate subject matter expertise from various elements within the regiment.
- Recommend, as appropriate, shifts of responsibilities for specific functions and/or force structures across the regiment.
- Develop a draft Unified Regimental Strategy for the Total Army Analysis process.

The Functional Responsibilities PAT used the Internet and a September 1996 meeting at Fort Leonard Wood to accomplish its mission. It described the various functions of Army engineers and determined which component of the regiment is the responsible advocate for each function. Figure 3 is a condensed version of the matrix developed by the PAT. The full version with 59 tasks is shown on the Unified Regiment home page. The matrix and a suggested implementation plan will be presented at the ENFORCE XXI-97 Conference.

The GOSC reviewed the results of the Functional Responsibilities PAT at its November meeting and acknowledged this work as the "dynamic baseline to portray functions within the regiment." The Functional Responsibilities PAT also identified several additional issues and recommended that the GOSC form PATs to examine them. These issues and the steering committee's decisions on which PATs to form are summarized below.

Tele-Engineering

To meet future demands for engineer support, we must find innovative ways to leverage the regiment's capabilities. Tele-engineering will provide some of

Engineer Functions Matrix—One Corps, One Regiment, One Fight (predominant responsibilities)							
Function/ Number of tasks	Element						
	Active	USAR	ARNG	USACE	DPW	HNS	Other
Project the Force (15)	P1/S2	P2/S2	P2/S2	S1	P1	HNS	ACSIM USAF/USN
Protect the Force (9)	P1	P2	P2	S1			
Gain Information Dominance (6)	P1	P2	P2	S1			NIMA (DMA)
Shape the Battlespace (4)	P1	P2	P2	S1			
Decisive Operations (7)	P1	P2	P2	S1			
Sustain the Force (10)	P2	P1	P1	S1			
Civil Support to the Nation (8)				P1			FEMA/EPA DOE/DOI
Legend: P1 = primary responsibility for function execution P2 = increased responsibility for execution as theater matures S1 = direct support responsibility S2 = supplemental support responsibility							

Figure 3

that leverage. Advanced communications provide unprecedented opportunities to link members of the Engineer Regiment. Operation Joint Endeavor gave us a real-world taste of what is coming. For example, soldiers and airmen in Bosnia measure snow depth, record weather conditions, and take river gage readings every 2 hours. Engineers relay these readings electronically to military and civilian experts at the USACE Cold Regions Research and Engineering Laboratory and the Waterways Experiment Station. These experts combine the data with imagery and hydrologic models to produce daily forecasts on the Sava River level and river basin snow maps. Then they send the unclassified results directly to the field via the Internet. This sort of "split-based operation," where technical products and advice are transmitted from the continental United States to deployed forces, greatly enhances our ability to support contingency operations. However, engineers must continue to provide on-site support to ensure that the expertise of the entire Engineer Regiment is effectively applied during contingency operations. Tele-engineering includes enhancing the deployability of USACE and Directorate of Public Works (DPW) soldiers and civilians and developing timely operational plans that effectively use rapid response teams such as the USACE Contingency Real Estate Teams operating in Bosnia. The GOSC quickly marked this initiative as a "winner" for our future effectiveness and chartered a Tele-Engineering PAT. This PAT will give a status report at ENFORCE XXI-97.

Army Topography/ Terrain Visualization

The GOSC discussed the concept, implications, and identity of the "Topographer of the Army." They noted that topography was a prime candidate for re-engineering. We must articulate the penalties associated with the status quo—which is a confusing dichotomy of responsibilities caught between two elements of the Engineer Regiment and the intelligence contingent under the Deputy Chief of Staff for Intelligence. The GOSC recommended, as a first step, that a PAT composed of Engineer School and USACE representatives develop a matrix of topographic functions and responsibilities. The next step will be a memo to the Deputy Chief of Staff for Intelligence inviting the intelligence community to join the PAT. This expanded regimental effort would help design the future of Army topography. The PAT will report the status of their effort at ENFORCE XXI-97.

Demining and Unexploded Ordnance—Engineers and Explosive Ordnance Disposal (EOD)

The GOSC discussed how to design a synergistic vision of battlefield cooperation between combat engineers and EOD units to deal with explosive devices (such as mines, booby traps, unexploded ordnance, and cluster munitions). Engineers clearly have the lead for breaching operations. Ordnance EOD units clearly have the lead for all "render-safe" procedures. The gray area is in

One Team—Focused!

By Major General Sam Kem (Retired)

Let's stay grounded and focused. That is tough to do these days, with bursting technology, exponentially expanding demands for information, and missions that seemingly change daily. New enthusiasms "dictate" new priorities that press against already strained resources. There are many distractions—aggressively worked by energetic people—that vie to dissipate the Engineer Regiment's focus and the focus of those who care so deeply for our regiment's future.

The value of *One Corps, One Regiment, One Fight* is that it must be a clarion call for all: To be one team, focused to—

- Ensure that we best serve our nation and our Army.
- Provide the engineer soldier and civilian the tools he/she must have to do the job.
- Grow and nurture our leadership to contribute effectively in our changing Army.
- Develop our soldiers and civilians to be all they can be.

In short, that means we must ensure that our Army engineer organization (One Corps, One Regiment) remains relevant to the Army's mission; responsive to both battlefield and national needs; and organized, equipped, and trained for the fight.

Success sometimes is measured by battlefield victory, a project constructed, or a major economic/physical disaster avoided or mitigated. Unseen and unnoticed in such dramatic times are those who fight the other battles—budgets, force structure, doctrine, national priorities, reorganization, material fielding, and personnel training and development—that allowed the big victory to happen.

The joint effort initiated by USACE and the Engineer School under the *One Corps, One Regiment, One Fight* banner can be an exercise in words—or it can provide the focus on what is important. Determining what is important—what is *vital*—is an essential task in today's rapidly changing environment. That and marshaling the resources to bring a solution is the task of our leaders.

It is right that we be *One Corps, One Regiment, One Team*. There is work to be done. Let's do it!

Major General Sam Kem (R) is the Honorary Colonel of the Engineer Regiment. He served as commandant of the Engineer School from 1984 to 1987.

clearing operations and support to civilian demining operations. To resolve this issue, we must clearly delineate the roles and missions based on the type and scope of operations. The GOSC recommended that Colonel Steve Hawkins, Commander of the 1st Armored Division Engineer Brigade, examine the issue from his Bosnian perspective. As part of this issue, the GOSC was briefed on the Engineer School's initiative to establish a resourced national Humanitarian Demining Operations Training Center. They discussed the problems USACE faced in cleaning up formerly used defense sites and the likelihood of some technology and procedural exchanges. The GOSC requested additional information on this initiative.

Engineer Doctrine Improvement

The GOSC concluded that our Engineer Regiment does as well as other proponents in creating doctrine. The problem is the current slow "industrial-age" process of writing, reviewing, editing, and publishing doctrine. They noted that engineers habitually use U.S. Army captains, allied officers, and Department of Army civilians to write doctrine. We now can electronically enlist the help of the broader engineer community, including many outside the Engineer School with a depth of appropriate experience. The Engineer School has noted that conventional doctrine development suffers from a whip-saw effect from changing priorities and resource levels. The GOSC recommended that the Engineer School develop a strategy to use our "distinguished alumni" to expand the base of doctrine expertise.

Inspire the Regiment

An observation from many who have served on the Army Staff is that engineers typically do not promote their interests or "stand together" within the key decision nodes in the national capital area. There is also a perceived sense of "distance from the proponent" expressed by our students at senior service colleges. The school's *Engineer* magazine is a well-established way to get guidance out and discourse started. The Engineer Regiment has about 200 retired general officers; we must ensure that they receive *Engineer* magazine. The same holds true for our retired Senior Executive Service retirees. Other means of distributing information include:

- U.S. Total Army Personnel Command's *Engineer Officer Bulletin*
- Army Engineer Association's *The Army Engineer* magazine
- Engineer School "Staff Notes to the Field"
- USACE Program Analysis and Evaluation "Questions and Answers" sheets

The GOSC approved a PAT to examine this issue and directed it to develop a comprehensive platform for discussing sensitive issues among the regiment.

Training is the glue that holds the Army together. Not an original observation on our part by any account, but it's just as important for our civilian components as for our soldiers. To be able to respond to our nation's needs, from warfighting to coping with natural disasters, the Engineer Regiment must develop a relevant and flexible training strategy. As our doctrine evolves, so must our training strategy change to produce meaningful individual and collective training. It does no good—indeed, it does great harm—for us to devote time and other resources to train on irrelevant processes. Only through a cooperative and collective effort across the regiment can we determine our essential training needs.

The U.S. Army Engineer Regiment has many constituent parts: TOE units in Active Army, Army Reserve (USAR), and Army National Guard (ARNG); and TDA elements, which include the engineer training base (Engineer School), the Directorate of Public Works, and USACE. These elements employ Department of the Army civilians and contractors, who are part of our team. USACE operates divisions, districts, and laboratories throughout the world. Army engineers are assigned to the Department of Defense and commands such as the National Imagery and Mapping Agency (NIMA). Finally, an important part of our team is our alumni—our retired community. It is all too easy to polarize the components of such a diverse organization, especially during a budget war in which each component tries to protect its own turf. We must not let that happen! *One Corps, One Regiment, One Fight!*

The first step toward organizational health is acknowledging the problem. We have taken this step. Now, we must go beyond that and energize the processes that will eventually become self-sustaining. Prior to ENFORCE XXI-96, we created a vision for the Engineer Regiment: *"Trained and ready, a rapidly deployable and versatile member of the strategic force...combining efficiencies of information with physical and technical capabilities, to master terrain in support of decisive victory."* We must press on to achieve this vision. The spirit of *One Corps, One Regiment, One Fight* will ensure success for the engineers, the Army, and our nation!



Brigadier General Anderson is the Assistant Chief of Engineers for Military Programs, U.S. Army Corps of Engineers. He previously served as the assistant commandant of the Engineer School.

Brigadier General Aadland is the assistant commandant of the Engineer School. He previously served as the chief of staff of the Engineer School and Commander, 2nd Armored Division, Engineer Brigade, Fort Hood, Texas.

The Commander's Thought



By Major General Clair F. Gill

Is SHE an Engineer?

The engineer branch expanded the opportunities for its female officers back in October 1994. Today, all engineer officer positions, except combat line company commanders and platoon leaders, are open to women. However, many maneuver officers, as well as officers within our own corps, are still unaware that the Corps of Engineers fully supports placing women in units that directly support the front-line commander. The title question—*Is SHE an Engineer?*—is still sometimes asked when maneuver commanders receive support from bridging, construction, and even their own habitually associated combat engineer units.

The versatility of the engineer officer is one of our branch's greatest strengths. All engineer officers receive the same training. The responsibility for providing these trained officers opportunities to develop their diverse skills rests squarely on the shoulders of our field commanders. Female engineer officers have served successfully in all of the major deployments in the last several years—and they will continue to do so. Today's engineer commanders must invest in their junior female officers and expose them to the full range of corps capabilities. This investment will ensure that all of the corps' future leaders have the full range of skills required to meet our branch's diverse mission.

The face of the engineer officer may have changed, but the quality of support provided to the commander has not. How do the maneuver officers that you work with react when a female engineer officer shows up at the tactical operations center ready to meet the challenge of **ESSAYONS?**

Force XXI Engineers:

New Organization Misfires in the Breach

By Lieutenant Colonel Bruce Porter

The Army is experimenting with options for a new heavy (armored and mechanized) division design, called *Division XXI*, as part of the Force XXI program. One significant option, promulgated by Training and Doctrine Command (TRADOC), involves reducing the number of mechanized engineer battalions in each heavy division from three to two. This "new" design is not based on innovative concepts or breakthrough technologies. It is a retreat to Cold-War thinking in a myopic attempt to save manpower spaces. The new design replicates a structure that failed in both World War II and the Cold War and was fixed only with tremendous effort during the Persian Gulf War. More importantly, when the principles of *Army Vision 2010* and *Joint Vision 2010* are used as a basis for analysis, the new engineer design proves to be a poor, perhaps catastrophic, choice for the combined arms team of the future.

Background

Army force structures in World War II and the Cold War authorized one engineer battalion to be organic to each division. The resulting task organization of just one engineer company to each ground maneuver brigade (or its equivalent) was absolutely insufficient in close combat operations. The corresponding "fix" in both World War II and the Cold War was doctrinal—to task organize a corps combat engineer battalion to the division. The technique worked well in World War II when the mission involved construction. It did not work for missions requiring synchronized

infantry-tank-engineer combined arms operations. To remedy this weakness, the official after-action report for World War II called for a full engineer regiment in each armored division. That recommendation was not acted upon in the rush to demobilize after the war.

The various types of divisions established during the Cold War experienced similar problems with insufficient division engineers. Again, they relied on a corps engineer battalion for augmentation. Task organization of two engineer battalions across three ground maneuver brigades (a matchup of eight engineer companies against 10 ground maneuver battalions), plus a cavalry squadron, was highly problematic. There was no way to coherently organize a division-level staff and three battalion staffs out of two standard battalion staffs.

Evolutionary Progress

The revolution in training inspired by the National Training Center (NTC) resulted in an unintended evolution of the maneuver/engineer task organization throughout the 1980s. Over time, maneuver units established that the "natural" pattern of operation was one engineer company per maneuver battalion task force (to include cavalry squadrons). When the NTC first opened, one engineer platoon usually was task organized to each deployed battalion task force. After a few years, a full three-platoon engineer company became the norm for each rotation to the NTC. After another few years, each battalion task force arrived at the NTC with a full engineer company (a total of

two engineer companies). By 1988, each brigade deployment included major pieces of the engineer battalion headquarters. In the NTC's close-to-combat environment, even when not a main division effort, the natural evolutionary process resulted in one engineer company per battalion task force and one engineer battalion headquarters per maneuver brigade headquarters.

This relationship was fully recognized by commanders at all levels at the start of Operation Desert Shield. Each heavy division deployed with its organic engineer battalion, plus two corps engineer battalions and some type of colonel-level headquarters. (The exception was the 1st Cavalry Division, which was placed in theater reserve.) For example, the 24th Infantry Division deployed to Operation Desert Shield with its organic 3rd Engineer Battalion, the 5th Engineer Battalion from Fort Leonard Wood, the 299th Engineer Battalion from Fort Sill, and the 36th Engineer Group headquarters from Fort Benning.

The practical process of force modernization leads to equipment fielding at uneven rates across the Army. Corps units are almost always out of step with any specific division with regard to modernization. For most corps units, the problem is one of inconvenience rather than actual danger, because corps units reinforcing a division typically don't engage in direct combat. The problem is more critical for combat engineers. For the 24th Infantry Division, the result was almost catastrophic: Corps engineer battalions had older rifles (with incompatible ammunition) but newer (and also incompatible) communications equipment than the divi-

sion. Perhaps worst of all, neither of the corps engineer battalions had started the mechanization process—the spectacle of engineers in dump trucks fighting alongside Bradleys and tanks was heroic but institutionally shameful.

Maneuver units receive artillery support via small fire-support cells using remote communications (the artillery is out of sight and well to the rear). Combat engineer units, however, execute missions from *within* the maneuver formation. Engineers, infantrymen, Bradleys, and tanks operate side by side in virtually every task from squad through battalion levels. Sapper teams are integrated into dismounted infantry squads. Tanks with mine plows operate as part of breaching engineer platoons, which in turn are task organized to infantry companies. Comprehensive tactics, techniques, and procedures must be developed at every echelon to coordinate and blend the talents and capabilities of specific commanders and their units.

Synchronizing a combined arms breach is arguably the most complex, difficult operation a commander can undertake. Engineers, infantrymen, and tankers must have absolute trust and confidence in one another, trust and confidence born of repetitive training and habitual relationships. Those capabilities cannot be assumed when some unknown unit from outside the organization arrives on the battlefield. Mutual trust and confidence certainly were not present when corps engineer battalions joined the 24th Infantry Division during the initial deployment for Operation Desert Shield. They were built over a 4-month period *after* the units deployed and intensively trained together in Saudi Arabia. Given that extended training period, strong motivation based on the certainty of imminent combat, and lack of distracters, the corps engineer units effectively became “divisional” units.

Almost immediately after American ground forces departed from Iraq, the Chief of Staff of the Army approved a new heavy division engineer structure that included a brigade

headquarters and three lean engineer battalions. That approval was based on years of analytic study and modeling by the Army. Additionally, the approval affirmed what had evolved over years of training at the NTC and acknowledged what had been proven to work in combat during Operation Desert Storm. The resulting force structure used no more manpower spaces than the previous two-battalion ad hoc design. It may be called the Army's first Force XXI organization.

Future Challenges

In contrast, the Division XXI engineer design now promulgated by TRADOC is just a rehash of already discounted concepts, disproven theories, and flawed Cold War designs. In fact, problems will be worse than those experienced in the Cold War. While engineer mobility assets decrease in the Division XXI design—

- Organic mobility capabilities of the maneuver unit remain constant.
- Requirements for maneuver unit mobility increase drastically.
- Enemy countermobility capabilities increase significantly.

The command and control problem of two engineer battalions applied against three ground maneuver brigades grows worse in Division XXI. The Division XXI engineer battalions are smaller and less capable than current battalions. The ability of corps engineer units to reinforce contingency divisions for close-combat synchronized operations has virtually evaporated due to the downsized Active Component force. (Almost 100 percent of all corps mechanized engineer battalions now are in the Reserve Components.)

The new division, to be fielded by 2010, will include only “product improvements” in the way of major weapons systems, with no improvement in the maneuver unit's mobility. Improved electronics will give com-

manders better intelligence about the enemy and terrain—but they will be unable to use it, because they will lack the engineer mobility assets to maneuver across the battlespace and overcome complex, dynamic enemy obstacles. Yet, the theme of “Dominant Maneuver” in *Joint Vision 2010* is clear:

Through a combination of asymmetric leverage, achieved by our positional advantages, as well as decisive speed and tempo, dominant maneuver allows us to apply decisive force to attack enemy centers of gravity at all levels and compels an adversary to either react from a position of disadvantage or quit ... Dominant maneuver will require forces that are adept at conducting sustained and synchronized operations from dispersed locations. They must be able to apply overwhelming force... These forces must have the ability to outpace and outmaneuver the enemy. Current systems, enhanced by information superiority, will provide a clearer picture of enemy and friendly locations. Information superiority also will allow joint commanders to coordinate widely dispersed units, receive accurate feedback, and execute more demanding, higher precision requirements. [Emphasis added.]

Army Vision 2010 establishes “Decisive Operations” as the Army's equivalent of “Dominant Maneuver.” The vision specifies the concept of “simultaneous, brief, violent attacks” enabled by “simultaneous application” and “mobility, speed, and agility.”

These visions provide a clear concept of tomorrow's battlefield: battalions that must disperse and fight autonomously on an increasingly nonlinear battlefield. Commanders will be expected to act quickly based on near-real-time intelligence. Implicit in this requirement is the need to preserve freedom of maneuver for the task force commander, to allow him to maneuver *where he wills* to best accomplish his mission, then to emplace dynamic

(Continued on page 34)



Maneuver Support Battle Lab: Integrating Maneuver Support Into Force XXI

By Vern Lowrey and Captain Bryan Green

The year was 2005. At the National Training Center, the sun was just breaking the horizon. SFC Strader chewed his cold fast ration as the incoming variable-message-format message blazed dull green on his heads-up display.

The lieutenant was sending the morning status report. SFC Strader thought the lieutenant had 1st Platoon spread a little too thin. Each engineer squad was supposed to dominate a 10-square-kilometer area. Under normal circumstances the five engineers in their heavy wheeled engineer armored vehicle (HEAVY) could handle it.

Another message scrolled across the heads-up display; this time it blinked in crimson. SFC Strader read the message as he told the driver to start the vehicle and retract the low observable screen system and false image generator. It looked as though the opposing forces (OPFOR) were trying to force them off the airhead. The OPFOR would attack the flank where only one Mobile Strike Force company, his engineer platoon, and a squad of military police in armored security vehicles were holding an economy-of-force mission.

The lieutenant sent each squad the digitized master obstacle and chemical contamination overlay. The OPFOR were on the move, but they were still four hours out. There was still time to reinforce the autonomous combat security outpost and other dynamic obstacles they had posted the day before.

Strader ordered SPC McKinney to launch two Night Owl unmanned aerial vehicles to recon the route to their obstacle

release point. As the Night Owls' saucer-like bodies lifted off the top of the HEAVY, SPC McKinney received infrared, ground-penetrating radar and acoustic images from their sensors as he guided them along the HEAVY's intended path to the obstacle release point. PVT Roberts drove the HEAVY out of its hiding position and followed the Night Owls down the combat trail.

SPC McKinney's voice came over the intercom, "Hey, the OPFOR laid some mines at the fork." The Night Owl transmitted targeting data to the on-board laser-munitions neutralizer. Without slowing, the laser-munitions neutralizer fired five bursts powerful enough to raise the buried mines' temperatures to a point that effectively neutralized them. Everyone prepared for a blast, because the laser sometimes missed a mine. Sure enough, the ModSAF simulation caused one to detonate right under the HEAVY...

This vignette describes a conceivable future virtual and live experimentation scenario where no one gets hurt but where soldiers and combat developers gain valuable insights regarding maneuver support DTLOMS (doctrine, training, leader development, organizations, materiel, and soldiers) programs. TRADOC's newest battle lab, the Maneuver Support Battlefield Laboratory (MSBL) provides direction, oversight, and horizontal integration of experiments related to the maneuver support enduring battlefield function. Maneuver support encompasses those actions taken to protect the force from the

effects of enemy/adversary action, provide the force freedom of movement during military operations, and inhibit the enemy/adversary's ability to move.

The Maneuver Support Battlefield Laboratory was officially organized at Fort Leonard Wood on 1 October 1996. Major General Clair Gill, commander of Fort Leonard Wood and commandant of the Engineer School, serves as the director. Colonel Ed Arnold serves as the deputy director for day-to-day operations. The commandants of the Army's Chemical, Engineer, and Military Police Schools form the battle lab's board of directors.

The MSBL coordinates the efforts of other TRADOC battle labs and schools in the maneuver support experimentation arena. It also exchanges information with industry, academia, major Army commands (such as the U.S. Army Intelligence and Security Command), Army components of the combatant warfighting commands (such as the U.S. Army Europe and Seventh U.S. Army component of U.S. European Command), various governmental laboratories and Department of Defense agencies, and other nations' battle labs (such as the German Army Battle Lab).

Experiments

The primary function of the MSBL is to conduct experiments on potential systems, techniques, and concepts and then input the most promising ones across Army DTLOMS programs. Most experiments are based on direct soldier and leader interaction with emerging technologies and materiel initiatives. The experiments support future materiel acquisition and assist with the development of future operational capabilities. They may be discrete, single events or progressive, iterative simulations (constructive, virtual, or live) designed to assess the military use and potential for new or revised concepts.

MSBL-led teams plan, conduct, and provide proponent evaluations to TRADOC. These teams focus on specific capabilities or technology opportunities. The experimentation process consists of design, planning and reviews, approval, execution, and the decision to invest or discard. The MSBL is the clearing house for all experiments within the maneuver support arena, including those related experiments that are to be conducted elsewhere.

Maneuver support experimentation produces one of the following recommendations:

- **Invest in the Warfighting Rapid Acquisition Process (WRAP).** Performed to accelerate fielding when mature technology fulfills an urgent need and experiments demonstrate compelling success.
- **Invest in non-WRAP.** Performed when the technology is successful and the normal requirements-determination process is satisfactory for fielding.
- **Experiment further.** Initiative appears to have merit, but further experimentation is needed to refine the DTLOMS requirements or develop the technology.
- **Discard.** Initiative does not meet the needs of the Army and merits no further investigation.

Types of Simulations

Most maneuver support experiments are conducted through iterative simulations that evaluate new ideas and technology. Modern simulations allow the Army to evaluate current and future force capabilities, determine requirements, and compare the contributions of alternative solutions. Simulations are divided into the following three categories, each with characteristic strengths and weaknesses:

Constructive simulations replicate warfare through computer-modeled war games. In some constructive simulations, the computer presents the participants with a graphic showing the operational situation and allows them to make decisions that influence the situation. Most constructive simulations employ models that war-game against a competent and active opponent. Others run independently of human interaction once the initial parameters and data are established. Constructive simulations replicate live exercises; simulate prototype technologies not currently available; vary the mission, threat, terrain, and weather; and repeat events until participants gain confidence in the outcomes.

Virtual simulations are conducted with electronic mock-ups of real weapons systems. The mock-ups use computers to replicate onboard systems and the external combat environment. Flight and tank-gunners simulators are representative of this type of simulation. Virtual simulations allow man-in-the-loop assessments of new DTLOMS programs. Simulators at various locations can be linked to offer a common warfighting picture for multiple elements of the force. Insights are derived at both operational and systems levels. The advantage of virtual simulations is the ability to have soldiers make warfighting decisions while computers analyze the effects.

Live simulations are exercises conducted by units in the field, preferably against a tactically competitive OPFOR. Live simulations are useful to experiment with new DTLOMS programs. They offer the advantage of using soldiers and equipment in an actual training environment. The advantage of realism in live simulations must be balanced against their expense and the inability to repeat training events.

The optimal solution in experimental analysis probably is to use a combination of the three simulation types. Live simulations offer the most realistic environment for analysis, but the cost may be prohibitive. Ideally, experiments should maximize the use of live and virtual simulations and augment them with constructive simulations. The ability to link live, virtual, and constructive simulations through the use of distributed interactive simulation (DIS) links facilitates the best use of all three types.

Fort Leonard Wood is working to establish a *Core Distributed Interactive Simulations Facility* by the year 2000. This facility will provide state-of-the-art simulation for experiments and exercises in a synthetic environment using distributed interactive technologies. The facility will be physically and electronically secure and have fully integrated, validated, and accredited simulators, models, and tools. State-of-the-art reconfigurable, virtual simulators will represent the full functionality and capability of a battalion task force. The facility will provide realistic command, control, communications, computers, and intelligence (C4I), including battlefield effects. Users will have

access to repositories of standard databases, representations, algorithms, symbols, scenarios, and other data. They can access realistic resolution terrain databases with a variety of terrain types, conditions, and climates. The facility will support concept evaluation; requirements determination; crew, unit, command, and battle staff training; technology development and evaluation; system development; test and evaluation; tactics and doctrine development; and force modernization.

Current Experiments

The MSBL currently is involved with Force XXI and Army After Next tests and experiments. (Force XXI is concerned with operations between the years 2000 and 2010. Army After Next is concerned with operations after 2020.) The battle lab focuses experiments and analysis efforts to—

- Analyze operational impacts of various Force XXI and Army After Next designs of maneuver support forces.
- Leverage emerging technology to improve digital terrain data acquisition, storage, updates, dissemination, and exploitation on the battlefield.
- Provide an integrated joint force-protection strategy against nuclear, biological, and chemical (NBC) weapons and associated threats. This effort spans the spectrum of conflict from chemical and biological counterterrorism and industrial hazards during military operations to NBC defense during full-scale combat operations.
- Enhance counterproliferation initiatives for weapons of mass destruction.
- Enhance NBC defense capabilities in operations other than war.
- Integrate NBC defense into the passive sensors of the theater missile defense system.
- Provide an NBC defense battle management system that is integrated into Army command and control systems to leverage information technology in Force XXI and Army After Next operations.
- Identify military technologies that can be applied in military and civilian counterdrug operations.
- Provide capabilities needed to conduct land countermine operations.
- Analyze physical security requirements and capabilities for Force XXI operations, including nonlethal technologies and land mines, robotics, and antiterrorist activities.

The battle lab began limited experiments during 2nd quarter FY97, including several Concept Evaluation Program experiments. It is now the sponsor of the Autonomous Remote Chemical and Biological Agent Sensor—Advanced Concepts and Technology (ACT) II program and will receive sponsorship of the Biological Detection—Advanced Technology Demonstration (ATD) on 1 October 1997. The Dismounted Battlespace Battle Lab continues current proponent efforts involved with the Task Force XXI and Division XXI Advanced Warfighting Experiments (AWE) and Prairie Warrior 97.

Insights gleaned from FY97 experimentation include:

- The Hornet (wide-area munition) is a clear “winner.”
- The proposed Division XXI engineer group design is inadequate to support full-spectrum division operations.
- Collecting, storing, updating, and disseminating high-resolution digital terrain data are critical elements of the commander's battlefield visualization program.
- Maneuver brigades require dedicated terrain analysis capability.
- An automated NBC early warning system is required for force protection.

Experimentation in FY97 resulted in the following recommendations:

- Possible WRAP investment systems include: Assault Breach Marking System (ABMS), Downsized Digitized Topographic Support System (DTSS), Digital Reconnaissance System (DRS), and Miniflail Mine-Clearing System.
- Requirements to be documented include: Antipersonnel Obstacle-Breaching System (APOBS), intelligent minefield (IMF), and vehicle teleoperation capability (VTC).
- Systems requiring further experimentation include: Ground and Hand-Held Standoff Mine-Detection Systems (G-STAMIDS and H-STAMIDS), biological detection systems, digital terrain data dissemination through long-range communications systems.
- No experiments currently are scheduled to be discarded.

For further information, contact the Maneuver Support Battle Lab: Colonel Ed Arnold, Lieutenant Colonel Bill McCoy, or Mr. Vern Lowrey (573) 563-4082, DSN 676-4082, fax 4089. e-mail: arnolde@wood-vines.army.mil, mccoyw@wood-vines.army.mil, lowreyv@wood-vines.army.mil.



Mr. Lowrey serves as technical director of the Maneuver Support Battle Lab at Fort Leonard Wood. He is commander of the 1138th Engineer Battalion (First Missouri), Missouri National Guard.

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Thriving on Base Camps

By Lieutenant Colonel John R. Jones

It was a privilege as well as professionally rewarding to have supported the soldiers and civilians involved in Operation Joint Endeavor in the former Yugoslavia. This is the largest military operation in the history of the NATO alliance. The initial U.S. portion of this 60,000-troop contingent was about 20,000 soldiers, who formed Task Force Eagle. The 1st Armored Division formed the core of the task force.

To support U.S. forces, base camps were quickly planned, constructed, and sustained. This was accomplished by the U.S. Army Corps of Engineers (USACE), the 1st Armored Division Engineer Brigade (DIVENG), the Logistics Civil Augmentation Program (LOGCAP) contractor, and the Base Camp Coordinating Agency (BCCA). The BCCA served as the focal point for building, sustaining, and decommissioning all U.S. base camps in Bosnia-Herzegovina and Croatia.

This article describes how the BCCA supported the base camp mission from June through October 1996 during my tenure as the BCCA chief. Included are some insights and "flashes of the obvious" that I believe are key ingredients to

successful mission execution in the Balkans. My intent is that these insights and flashes of the obvious will help others in the years ahead.

Command and Control

Task Force Eagle formed the nondoctrinal BCCA early in the deployment (January 1996) to plan, coordinate, and execute the urgent base camp construction mission. The BCCA was at the confluence of various organizations, to include USACE, DIVENG, U.S. Army Europe (Forward), and the LOGCAP contractor. To ensure functional interdependence, the BCCA coordinated extensively with all of these organizations while simultaneously taking direction from the 1st Armored Division Assistant Division Commander-Support (ADC-S).

Organization

The BCCA, a hybrid of a Directorate of Public Works and a USACE resident field office, was organized into five branches.

- The *Plans and Operations Branch* focused on both current and future operations. BCCA planners ensured that camp perspectives were integrated into all future Task Force Eagle operations. This included task force reshaping, support for national elections, redeployment, and transition of mission responsibilities to the covering force (1st Infantry Division).
- The *Environmental Branch* administered USACE environmental contracts and facilitated the education and assessment of environmental programs at each base camp.
- The *Base Camp Assistance Team (BCAT)*, an "over-the-road" team, focused on training, assisting, and assessing all base camps.
- The *Project Management Branch*, formed late in the operation, was responsible for funding, customer interface, project monitoring, troubleshooting, and reporting.
- The *Real Estate Branch* acquired, managed, and disposed of land and facilities. To improve responsiveness, reduce over-the-road time, and provide continuity of care, the BCCA established two field offices and positioned them in the northern and southern halves of the U.S. sector.

Special staff in the functional areas of preventive medicine, safety, ammunition storage, and fire safety augmented the BCCA.

Staffing

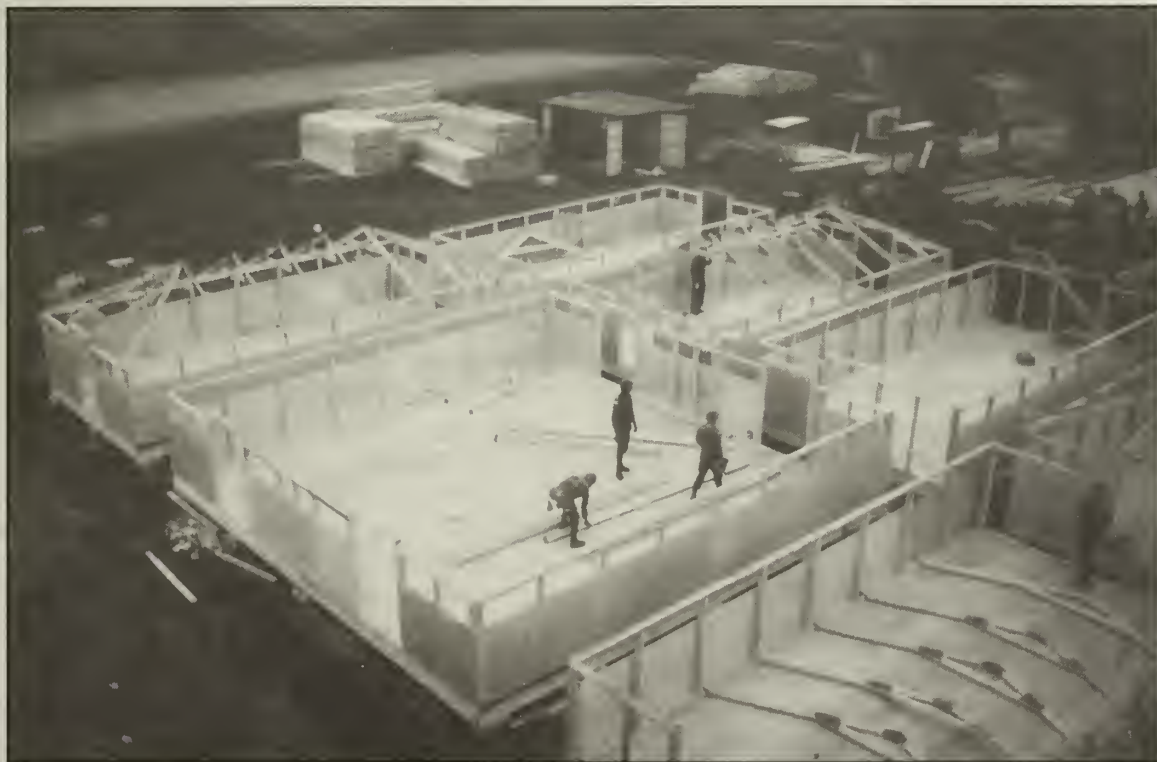
BCCA staffing at its peak totaled 40 personnel. It included USACE active duty officers and individual

mobilization augmentees, 412th Engineer Command personnel, U.S. Army Europe and 1st Armored Division augmentees, and Department of the Army (DA) civilians. The civilians provided expertise in real estate, safety, ammunition storage, and environmental engineering. Beginning in August 1996, the Army Audit Agency assisted the BCCA in process development and validation. As U.S. force levels were reduced from October through December 1996, the BCCA evolved into a leaner organization.

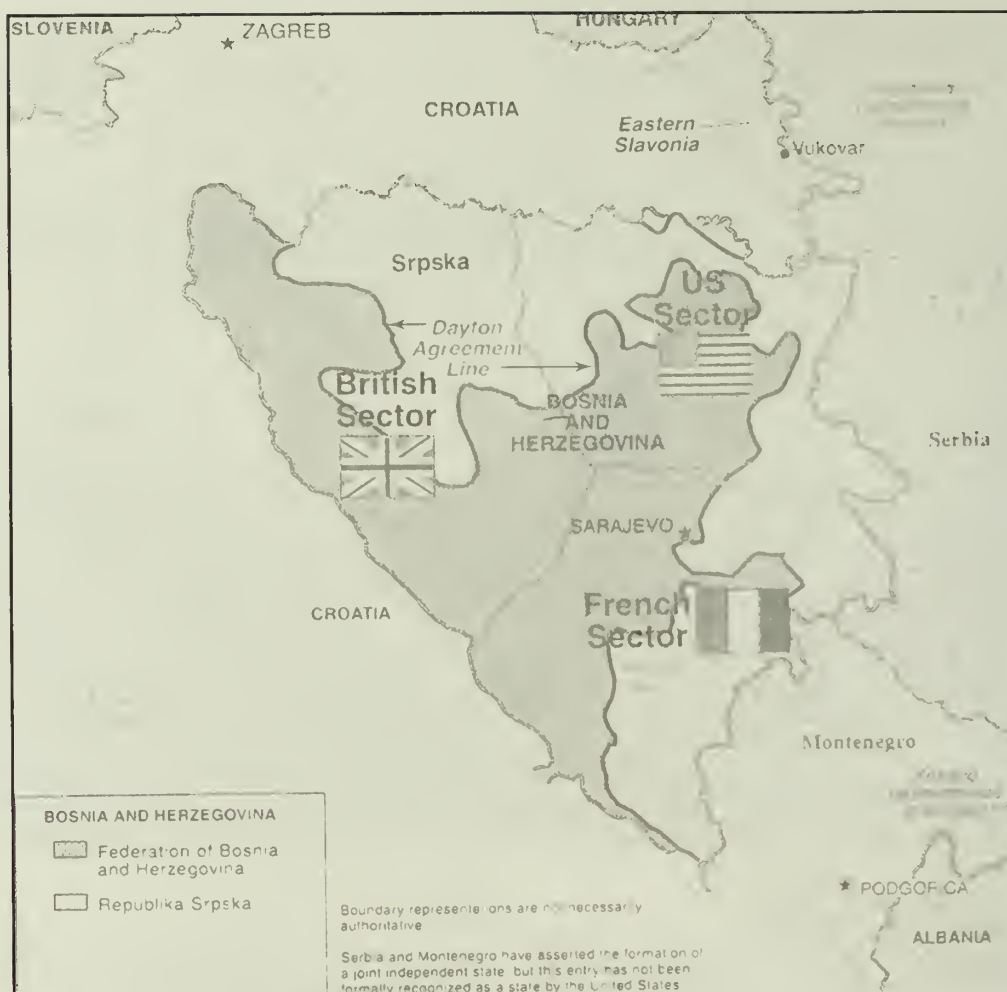
Base Camp Standards

Task Force Eagle established standards up front that addressed living and support facilities as well as force-protection measures. Both *interim standards* (less than 30 days) and *duration standards* (more than 30 days) were established. The goal was to improve safety and provide consistent and prudent quality-of-life levels throughout the U.S. sector.

Interim and duration living standards for the general-purpose, medium, tents were 15 and 10 soldiers per tent, respectively. Other accommodations included fixed facilities and living containers. Additionally, a total of six Force Provider sets (each housing and supporting 550 soldiers) were installed on three base camps. For hasty insertions, Force Provider sets are convenient; however, maintenance is high as are costs to decommission, clean, and repackage them for reuse. The duration standard for showers and latrines was one shower head and latrine per 25



1AD DIVENG units construct tent frames at a U.S. base camp in support of Operation Joint Endeavor.



Twenty-two U.S. base camps were scattered throughout the U.S. sector in Bosnia-Herzegovina. One U.S. base camp was located in Croatia, along the Sava River.

soldiers. Lighting, heating, and hard floors were in all duration standard tents. There were facilities on each base camp for dining; a chapel; a laundry; and morale, welfare, and recreation (MWR) activities. Base camp population determined the number of tents for support and administrative facilities.

Task Force Eagle's force-protection standards ensured that every soldier had access to a bunker or fighting position. The task force also developed standards for perimeter lighting, fencing, guard towers, ammunition holding areas, and helipads. Base camp site selection criteria addressed items such as trafficability, living and motor park space, defendability, communications, water source, and main supply route accessibility.

Base Camp Construction

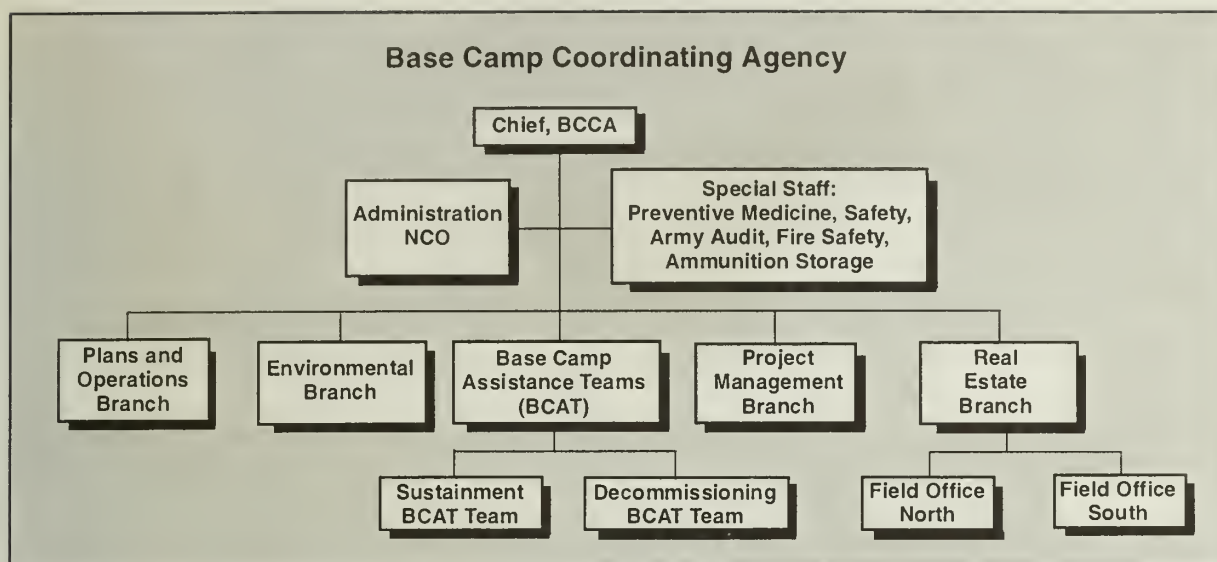
U.S. Army engineer battalions, a U.S. Navy Seabee battalion, a U.S. Air Force RED HORSE battalion, and the LOGCAP contractor (Brown & Root Services Corporation) shared responsibility for constructing 23 base camps in the U.S. sector. USACE (specifically the

Transatlantic Program Center in Winchester, Virginia) administered the LOGCAP contract (*Engineer*, March 1997, page 2).

LOGCAP, an Army program, uses a civilian contractor to perform selected services to augment U.S. forces during a military operation. Tapping into this program allowed the best use of our engineer resources. For Operation Joint Endeavor, Brown & Root provided base camp construction and sustainment services as well as some logistics support services (i.e. transportation, maintenance, supply, laundry, and dining facilities). Each base camp had a Brown & Root manager and staff to fulfill construction, sustainment, and decommissioning contractual requirements. Herculean efforts by the entire engineer team ensured that construction was executed to standard with no compromise of the soldiers' safety or quality of life.

Base Camp Leadership

Senior base camp leaders, the BCCA, and Brown & Root shared responsibility for operations and maintenance. There were 22 base camps in



Organizational structure of the Base Camp Coordinating Agency (BCCA)

Bosnia-Herzegovina and one in Croatia, each housing from 200 to 2,500 soldiers. Each senior base camp tactical commander appointed a "mayor" to assume camp leadership responsibilities. The mayors worked closely with the Brown & Root camp manager, the DIVENG direct support unit, and the BCCA. Since mayors required the knowledge to "run" a base camp, the BCCA developed and sponsored necessary training. One course focused on operations and maintenance and the other on decommissioning. Topics included real estate, environmental programs, operations and maintenance, local contracting practices, LOGCAP rules, DIVENG roles, civil-military affairs, safety, property accountability, force protection, preventive medicine, ammunition storage, and MWR responsibilities.

Town Hall Meetings

The BCCA facilitated regional town hall meetings every two weeks at various base camps throughout the sector. These meetings provided a forum for discussion and problem solving. Attendees included the ADC-S, the BCCA chief, base camp mayors, and senior tactical commander representatives (usually brigade and battalion executive officers), the Task Force Eagle G4 and Property Book Officer, Brown & Root camp managers, BCCA project managers and real estate specialists, force-protection and safety experts, and representatives from DIVENG and MWR. These command-sponsored events encouraged dialogue, built trust, and allowed issues to be addressed quickly.

Business Practices

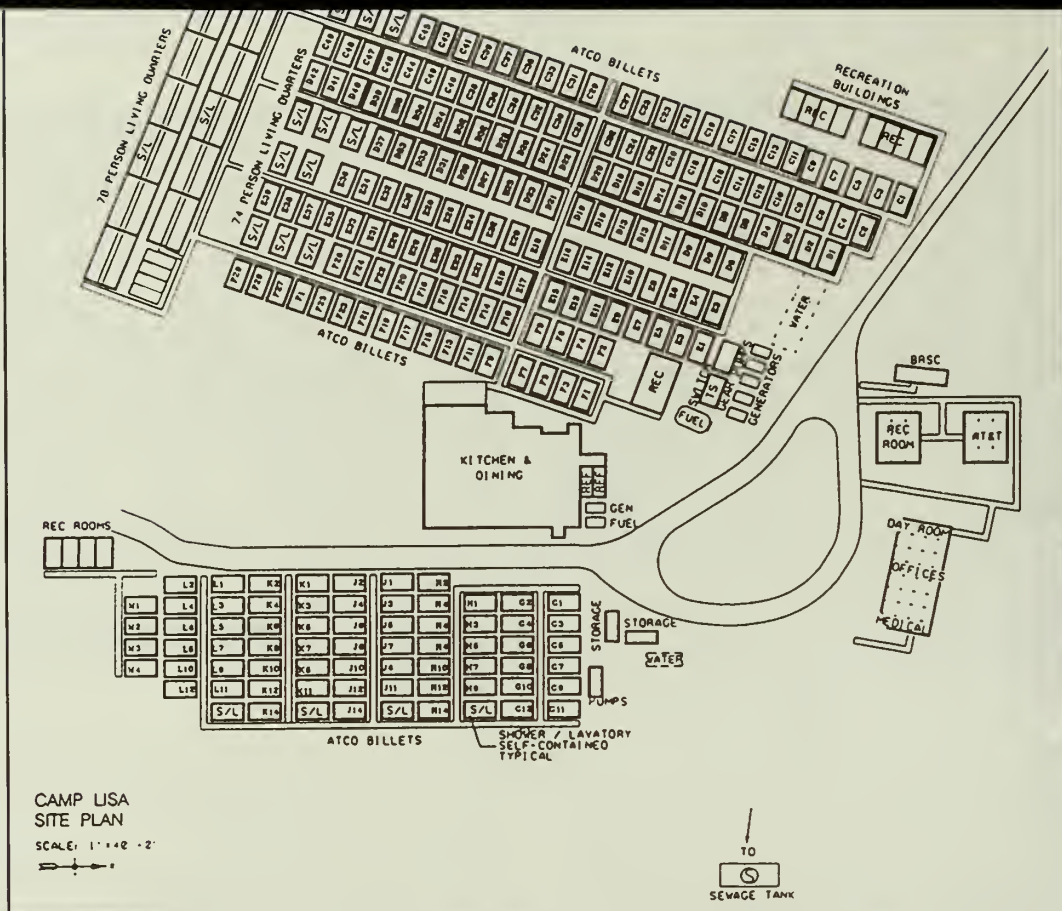
Task Force Eagle established a Joint Acquisition Review Board (JARB). This common-sense, better-business-practices group included the BCCA chief

(the JARB president) and the Task Force Eagle resource manager, G4, G3, and a Staff Judge Adjutant advisor. All new base camp work required JARB review and ADC-S approval. Any soldier or unit could initiate a work order. Then it went to the base camp mayor for approval and on to DIVENG (usually the engineer battalion in direct support to that base camp) for review and action. DIVENG could recommend disapproval, execute the work order, or forward it to the JARB. Work orders costing more than \$2,500 required JARB review and approval; those less than \$2,500 were acted on by the BCCA chief. The task force review process saved money, standardized procedures, developed practical low-cost solutions to requests, and promoted safety and consistent quality of life on base camps.

Base Camp Assistance Visits

The Base Camp Assistance Team (BCAT) visited sustainment camps every four weeks and decommissioning camps every two to three weeks. On these visits, the team concentrated on education, training, and assistance, although it also conducted a base camp assessment and reported to the Task Force Eagle command group after every visit. Based on published standards and approved definitions, the BCAT assessed four major areas:

- **Force protection**—local national screening, perimeter integrity, risk assessment, ammunition storage, and weapons security.
- **Environmental program**—spill prevention, spill response, hazardous-waste and hazardous-material disposal, and petroleum, oil, and lubricants (POL) transfer operations.
- **Preventive medicine**—dining facility operations, water supply, and vector and rodent control and repellent systems.
- **Safety**—fire safety, living area safety, motor pool safety, and accident prevention program.



An example of a U.S. base camp facilities site plan, exclusive of site perimeter and force protection measures.

Coupling outstanding base camp leadership with BCAT visits ensured that all base camps complied with established Task Force Eagle standards.

Environmental Program

The Task Force Eagle environmental program was proactive and highly effective. BCAT team visits always included a BCCA environmental representative who promoted, trained, and enforced the established environmental standards (*Engineer*, March 1997, page 12). Every BCAT visit and town hall meeting stressed items such as spill prevention, hazardous-waste and hazardous-material management, safe POL transfer point operations, and spill response capabilities. Before a base camp was occupied, an environmental baseline survey was done to acquire a benchmark. A final survey was conducted when the camp was decommissioned. Task Force Eagle then took appropriate actions to mitigate differences between the two surveys.

Proof of this effective environmental program was reflected in the minimal corrective environmental actions required when base camps were decommissioned.

Base Camp Decommissioning

As the U.S. reduced its presence in Bosnia-Herzegovina, it decommissioned base camps in a deliberate, safe, and disciplined manner, using a

process developed by DIVENG and BCCA. Force protection and stewardship of government property were critical. The senior base camp tactical commanders responsible for decommissioning their camps applied lessons that were learned early in the operation. Base camp complexity, location, and size determined the decommissioning time and effort, but the phased process usually took about six weeks. The decommissioning team consisted of tenant units, DIVENG assets, and the LOGCAP contractor. Base camp leaders, with the advice and assistance of BCCA and DIVENG, orchestrated the work.

The phased decommissioning process collapsed the camp in on itself. Soldier support facilities (the shopette, chapel, library, and MWR facilities) were removed first, followed by life-support facilities (dining facilities, tents, showers, and latrines). Bare essential life-support facilities and force-protection infrastructure (concertina wire, guard towers, and fighting positions) were removed last. BCAT closure team visits to base camps anticipated and solved problems as they arose and assessed and monitored progress. On the final visit, a clearance checklist (similar to a range control checklist) served as the clearance document. Harvesting material from decommissioning base camps was deliberate and saved money. Essentially, all base camp expansions and improvements after June 1996 were completed at little cost using harvested materials (gravel, lumber, tents, shower and

latrine facilities, force-protection material, and electrical and plumbing equipment) from decommissioning base camps. BCCA served as the clearing house for all harvested materials. Once items were identified as base camp excess, they went on the harvest list for transfer to a base camp with a valid need.

Base Camp Transition

The outgoing 1st Armored Division and the incoming 1st Infantry Division developed a memorandum of agreement that addressed which base camps would be kept, their respective capacities and capabilities, transfer dates, and which unit would accept responsibility for each camp. The BCCA played an important role during the transition process to ensure that incoming 1ID leaders understood the base camp mission.

The units developed transition plans for each base camp to be retained. Outgoing and incoming leaders executed these plans to standard, which included training (sponsored by BCCA), a 100-percent property inventory between mayors, transitioning the base camp smart book, and conducting a joint walk-through.

Flashes of the Obvious

- When your boss asks you to go do great things in a far-away land, go for it.
- Nothing is more important than applying common sense and keeping things simple—so tired and confused people can understand and quickly get on with the task at hand.
- Bad news seldom improves with age. If you have a problem you cannot resolve, surface it. Task Force Eagle rarely shot the messenger and quickly addressed issues.
- View obstacles as a transient state—something to be solved along the pathway to excellence. Press the fight.
- Establish base camp standards early, and enforce them consistently. The desire to improve base camps above established standards was immense, but established and understood standards helped squelch that desire.
- Underwrite honest mistakes. Perfectionists in the Balkans did not do well. Planning, preparing, and rehearsing paid dividends and eliminated most mistakes. Don't demand exactness. Don't chisel decisions in stone. Be willing to change as time unfolds and circumstances change.
- Gather information and critical items of interest by talking to people and visiting base camps. Don't hide behind your computer or telephone. Get near the action to listen and learn, but don't micromanage the action. Base camp

assistance visits and town hall meetings encourage dialogue and build trust.

- Make decisions quickly. Often there isn't time to sleep on an issue. Working in this environment brings a new meaning to decision making.
- Plan ahead. Focus your attention on the next few days, not the next few minutes. This advice is not always possible, but focus on the important things.
- Military operations cost a lot of money. Implement cost-saving measures such as joint acquisition boards, better business processes, and material-harvesting programs.
- Three equals one in the Balkans. It usually took three times as much effort, persistence, and time to execute missions in Bosnia-Herzegovina as in other places I have served. Plan accordingly and get over all the obstacles!
- Remember, a task is not finished until the soldier is living in it or using it.
- Teamwork is crucial—it's an attitude.
- Estimates are only estimates to the person making them; everyone else hears a fixed price or absolute schedule. The listener hears only the low end.
- Stay proactive. The champion-to-chump cycle can be short in this type of environment. Keep your head in the game.
- Activated reservists, DA civilians, and the LOGCAP contractor did a superb job.

Summary

Base camp accomplishments were many. Efforts by Task Force Eagle, USACE, DIVENG, and Brown & Root were extraordinary as they constructed, sustained, and decommissioned base camps—safely, quickly, and to standard. The safety and quality of life in these camps received high marks. Engineer efforts have played a large part in the success thus far of Operation Joint Endeavor, but another factor deserves a significant portion of the credit: the professionalism and selfless service of Task Force Eagle soldiers, DA civilians, activated reservists, and contractors. The men and women who are serving proudly and tirelessly are true patriots who have made a lasting difference to this war-torn region.



Lieutenant Colonel Jones is the Deputy Commander, St. Louis District, U.S. Army Corps of Engineers. In addition to serving as chief of the Base Camp Coordinating Agency in support of Operation Joint Endeavor, he has completed tours with the 3rd Armored Division, Germany; New York District, USACE; the 130th Engineer Brigade; and Operation Desert Shield/Desert Storm. LTC Jones holds a master's degree in civil engineering from Pennsylvania State University and is a registered professional engineer in Missouri.

Readiness:

DPW Supports Power Projection

By Colonel R. O. Buck

Fort Benning, Georgia, is one of the Army's 15 power-projection platforms. It is home to three combat units that have very short deployment "strings": the 3rd Brigade of the 3rd Infantry Division (headquartered at Fort Stewart, Georgia); the 75th Ranger Regiment headquarters and its 3rd Ranger Battalion; and the 36th Engineer Group. The rapid deployment of any of these units requires teamwork between the deploying unit and a host of post staff elements, as well as such off-post entities as the Corps of Engineers Savannah District. Fort Benning's Directorate of Public Works (DPW), with an in-house staff of 700 individuals, is a key member of the team. The following summary of DPW activities shows how critical the organization is to the smooth and rapid deployment of power-projection forces.

Master Planning. The DPW's involvement in power projection begins with master planning. Well before any deployment operation, the DPW master planning staff ensures that a myriad of up-to-date replacement facilities are properly documented and sited. Fort Benning currently is reaping the benefits of the Army's drive to place all permanent party soldiers in 1+1 barracks. (That is the desired new standard for enlisted unaccompanied personnel in permanent party barracks.) Several battalion barracks sets, valued at \$69 million, are under construction. The directorate's master planners also orchestrate the development of other supporting power-projection projects under the Army Strategic Mobility Program (ASMP). Included in this program is a \$4.6 million deployment warehouse (scheduled to be completed in May 1997) and a new \$9.4

million railhead facility (construction to start in the fall of 1997).

Facilities. Maintenance of existing facilities is vital to the ability of Fort Benning's power-projection units to deploy on a moment's notice. As on most Army installations, our operation and maintenance (O&M) funds are at a premium. Their expenditure reflects the priorities of Major General Carl Ernst, commandant of the Infantry School and commanding general of Fort Benning: safety, training, power projection, and quality of life.

Barracks. Many of Fort Benning's O&M dollars are programmed to repair existing barracks, which have an average age of 40 years. Virtually all of their major components (roofs; electrical, plumbing, and heating/cooling systems; and latrines) gradually are being repaired or replaced. Augmenting this effort is a robust U-Do-It program,



The new dining facility for the 3rd Infantry Brigade, 3rd Infantry Division, is currently ahead of schedule.



A renovated barracks complex soon to be occupied by soldiers in the 36th Engineer Group.

which allows soldiers to perform projects ranging from painting and wall papering to installing ceiling fans and tile floors.

Airfield. Sometimes, all the repair efforts in the world will not keep a system up and running. A case in point is the Lawson Army Airfield's electrical system. This airfield can support the largest military and commercial planes in existence. Keeping the electrical system (which powers all the navigational aids) in operating condition became a problematic undertaking, despite the best efforts of the airfield staff and DPW craftsmen. The solution? Another ASMP project that we put together in relatively short order.

Supplies and Materials. Another facet of the DPW's power-projection mission is acquisition and maintenance of material to support deployment operations. The DPW maintains a large stockpile of tie-down equipment and chock blocks for use in rail movements. (This remains a mission even though the use of modern rail cars is steadily diminishing the need for such material.) The DPW also keeps a large inventory of plywood on hand. It is used to preclude metal-to-metal contact on pallets and to lay on airfield ramps

for tracked vehicle movement. A stockpile of 4 x 4 material is used as shoring under pallet loads.

Time-Phased Actions. The extensive preparations and constant effort expended by units and many staff elements across the post prove their worth when a deployment operation kicks off. The choreography is remarkable and teamwork exceptional as all involved, including the DPW, focus on the mission at hand. The DPW has its own time-phased sequence of events, which includes activating established contracts for generators and portable toilets, hooking up light sets at the ammunition supply point and staging area, and issuing tie-down material, plywood, and timbers.

Short-Fused Taskers. Like all staff elements on post, the DPW responds quickly to each deploying unit's needs. We do our part to keep "Murphy" under control by, for example, repairing hanger heaters that suddenly fail, replacing blown light bulbs, and providing experienced forklift operators to load CONEXes on flatbed trailers. The DPW workforce also stands ready to tackle unique, short-fused taskers. For example, during Operation Just Cause in Panama, the directorate enlarged

architectural drawings of the palace for use by the 75th Ranger Regiment.

Seaport. The DPW's power-projection responsibilities extend beyond post boundaries. If a large deployment operation requires additional seaport capabilities, the DPW is part of a 250-person contingent from Fort Benning that proceeds to Jacksonville, Florida, to operate the military seaport. DPW missions include on-site contracting for housing and subsistence (to support the port support activity contingent) and acquiring and installing fencing needed to secure marshaling and holding areas at the port.

Fort Benning's DPW staff is an integral part of the post's power-projection mission. Working hand-in-hand with deploying units, the installation's many staff agencies, and various off-post organizations, the DPW helps ensure that Fort Benning is ready to project combat power on a moment's notice.



Colonel Buck is the Director for Public Works at Fort Benning, Georgia. Prior to assuming this position, he commanded the Detroit Engineer District. COL Buck is a graduate of the Army War College.

Letter to the Editor



National Training Center Notes: "Using Obstacle Group Designs," (*Engineer*, December 1996, page 52).

Major Buning contends that the only key to successful countermobility support at the task force level is to go back to individual obstacle planning—what I used to call the "green measles sheet." Before we take a step back to the Cold War General Defense Plan approach, we need to understand the impact and reasons for the lack of synchronization at the task force level. Major Buning states: "...it is a lesser training challenge to make lieutenants and platoon sergeants understand that they must site obstacles and adjust a given design to the terrain than to generate the design itself." He has successfully identified the problem: training. The solution, however, is not to centralize and remove responsibility for obstacle group execution from the platoon leaders' and sergeants' hands.

We have come a long way with the echelons of obstacle planning, obstacle intents, planning factors, and individual obstacle designs tied to lethality (probability of kill). The platoon leader and platoon sergeant must understand, in detail, obstacle groups. They must be trained. Critical for the platoon leader's success in supporting the combined arms team with countermobility is—

- Taking the obstacle intent (target, effect, and relative location) and tying that to the direct- and indirect-fire systems.
- Understanding the minefield density (lethality) and obstacle effects.
- Understanding the theory behind the obstacle designs.

Ask a recent graduate of the Engineer Officer Basic Course (EOBC) or the Advanced Noncommissioned Officer Course (ANCOC) why a fix or disrupt minefield is 250 meters wide and why a block or turn minefield is 500 meters wide. Ask them how the resource planning factors are derived or why certain minefields have irregular outer edges. You probably will see a "deer-in-the-headlights" look. Many combat engineers cannot answer those questions or do not understand the basis of the theory. This is unacceptable. If the problem is training, attack the problem. We do not throw away troop-leading procedures or the military decision-making process because soldiers cannot meet the standard. We do not institute company/team planning and execution requirements for the task force commander because subordinate unit commanders cannot execute their assigned missions. We train to

overcome deficiencies/shortfalls and to accomplish the mission or meet the standard. Platoon leaders and sergeants must be ready and able to not only "talk the talk" but "walk the walk." The challenge is there: Determine the weaknesses of EOBC and ANCOC and ensure that the program of instruction and doctrinal manuals address the problem. Then review home station training requirements. More than likely, the platoon leaders and sergeants were not held to standard by the engineer battalion and company commanders. Does the task force engineer get on the ground with the platoon leaders as they coordinate the obstacle group with the maneuver team commanders? Is it an Engineer Officer Advanced Course (EOAC) problem? Does EOAC provide the necessary instruction for potential company commanders so they can answer the questions (above) about obstacle theory? The Corps of Engineers must have the engineer platoons plan and execute obstacle groups in order to have a synchronized maneuver plan.

Much like the lessons learned by our maneuver counterparts, drawing a goose egg and some target reference points (TRPs) on an overlay will not ensure the proper positioning and synchronization of weapon systems. The maneuver team commander uses the graphics and task force commander's intent to properly place his weapons systems. He focuses on the TRPs with the task force commander and S3. Adjustments/movement of the actual battle position are the norm. Until the weapons systems are placed (especially to turn, fix and block), individual minefield planning is a waste of paper. The intent of the obstacle group symbol is to provide the flexibility needed for general top-down guidance and bottom-up detailed planning/execution. Obstacle resource factors are the planner's (the task force engineer's) tool to determine the necessary Class IV/V obstacle material requirements.

Major Buning has his fingers on the pulse for recurring engineer tactics, techniques, and procedures, and planning deficiencies. My concern is that we overreact to a training deficiency and create a paper drill for the task force engineer. The task force engineer who plans individual obstacles wastes his time and hinders his time management in getting with his platoon leaders and task force S3 to ensure that obstacle groups are constructed to standard and synchronized with direct- and indirect-fire systems.

Major Robert E. Wray, Jr.
Special Troops Battalion
USARAK, Fort Richardson, AK

Author's Reply

I appreciate Major Wray taking the time to write. His comments represent a healthy desire to fix a critical problem. They provide an opportunity for me to clarify once again what was not only my last article from the NTC but probably the most important one to date. My intent was not to cause an overreaction to an observed trend in training deficiencies in the tasks of company planning and platoon execution. Nor did I call for a return to the days of overpromising engineer capabilities fictitiously delivered in training, using textbook platoon planning factors and red and white engineer tape. I hope that this discussion causes all combat engineer leaders to review these articles (*Engineer*, CTC Notes, August and December 1996) in detail and to use them as part of their unit professional-development discussions.

My proposal that engineers use the obstacle group design as a planning tool is based on a well-founded appreciation of the problem and its causes, as well as suggestions from the NTC combat engineer training team. Whether units adopt this proposal is not as important as the wake-up call this idea represents. All combat engineers must assess their unit's ability to effectively and efficiently employ their combat engineer platoons. Solutions ultimately are generated by platoons that are proficient in battle drills and by company commanders who drill their staffs to produce executable plans.

I did not propose absolving any leaders from training to the highest standard of combined arms obstacle integration. I did state that the obstacle group design offers an effective planning tool that focuses on the weakest link in platoon execution—company planning products. Platoon leaders must receive an executable order that is rich in details, no matter what the form or how much time is available to produce it, if there is to be any hope of emplacing a synchronized obstacle system prior to the ordered defend time.

The bottom line is that doctrine drives our force structure. Engineer platoons are equipped and manned to be executors; that is our doctrine. There are no internal planning or significant logistical capabilities within the platoon; they must be provided by the company headquarters. Any effort the platoon directs toward planning and outside coordination to site obstacles to the terrain and the defender competes with the platoon's time and capability to emplace obstacles. Combat engineer leaders must establish a bedrock understanding of this concept in their organization. The level of their contribution to the combined arms team in preparing to fight the defense is directly proportional to the productivity of the engineer platoons. Commanders and their staffs maximize the efficiency and effectiveness of their engineer platoons by keeping their energy and focus on the doctrinal role of executing the plan.

Major Tom Buning



CTC Notes



Joint Readiness Training Center (JRTC)

The Engineer Platoon Sergeant

By Sergeant First Class Bernard Westover

Units rotating to the JRTC often do not use the engineer platoon sergeant to his fullest potential. Frequently, the platoon sergeant stays in the tactical operations center during the attack and in the mine dump during defensive preparation. This poor use of personnel reflects the "old days," when the platoon sergeant just provided the "beans and bullets" as his unit went on the attack or the defense.

On today's battlefield, the demands on leaders to provide purpose, direction, and motivation are greater than ever. The platoon sergeant is the keystone of the platoon. The most knowledgeable and experienced soldier in the unit, he must lead by example and shoulder more than his share of the headquarters' responsibility every day. The platoon sergeant is the link between the squad leader and the platoon leader. In the absence of the platoon leader, the platoon sergeant serves as the task force engineer (a staff officer) to plan and execute mobility, countermobility, and survivability missions anywhere in the world. Unit leaders must not overlook the tactical value and experience of a platoon sergeant when planning a mission or to assist the platoon leader when executing a mission.

Today, subordinate leaders are selected for promotion earlier and have less experience in key leadership-developing positions like squad leader and team leader. The platoon sergeant must be decisively engaged in training battle drills and unit standing operating procedures (SOP). He coaches and mentors in garrison and provides that much-needed warrior spirit to junior leaders on simulated battlefields like those conducted at the combat training centers. Aggressive, take-charge leadership styles are not taught in the Noncommissioned Officer Education System schools and can only be instilled by a great role model—the noncommissioned officer (NCO).

In light, airborne, and air assault units, the platoon sergeant must be prepared to assume the duties and responsibilities of the task force engineer at any time. He must be ready to plan the next fight and lead the platoon into combat. The job of a sergeant at any level goes beyond teaching soldiers how to fight and survive. NCOs must forge the warrior spirit in soldiers and motivate them to do the hard right over the easy wrong. This motivation is a missing ingredient in some leadership styles observed at the JRTC.

Specific areas needing improvement and leader emphasis are—

- Writing squad orders with specific tasks and a clear purpose.
- Adhering to troop-leading procedures.
- Performing precombat inspections.
- Performing combined arms rehearsals.
- Providing security on mounted and dismounted movements.
- Executing missions effectively and in a timely manner.

The presence of an experienced platoon sergeant will solidify a platoon when soldiers are faced with fear, chaos, deprivation, hunger, or fatigue. Units that can overcome these physical factors and have platoon sergeants who lead by example and apply the skills and knowledge learned in training will overcome any opponent or obstacle in combat.

The platoon sergeant must train the platoon leader to be a task force engineer and train squad leaders to become platoon sergeants. During every rotation, platoon sergeants ask, "If we went on the attack, wouldn't I just micromanage the squad leaders?" The answer is a resounding "No!" At the JRTC, the platoon sergeant can clearly assess how subordinates react under stress. He is a link between the infantry company commander and the engineer squad leaders at the breach point. There he can control the breach forces and elements of SOSR (suppress, obscure, secure and reduce) while squads conduct the breach. When soldiers' lives are threatened, his experience is the greatest asset on the battlefield. He can make that split-second decision that means the difference between success and failure.

At the objective, the platoon sergeant supervises the reorganization and redistribution of ammunition and equipment. He tracks the status of personnel, evacuates the wounded and killed, and reports those missing in action to higher headquarters. If necessary, the platoon sergeant also prepares for the countermobility effort to defend the objective. He quickly reorganizes the platoon to clear routes into the objective for resupply, casualty evacuation, and reinforcements.

The engineer platoon sergeant has a unique job because the engineer field is diverse and demanding. He provides leadership to squad leaders and trains the platoon leader to effectively accomplish his mission. The platoon sergeant does not accompany every squad leader on every mission. His presence, however, is critical when the task force conducts a mission where the platoon is task organized with the main effort. His tactical and technical experience cannot be transmitted over the radio. When the platoon is in the heat of battle, conducting a breach or route clearance mission, the platoon sergeant must be on the ground to provide the direction and leadership needed to accomplish the mission.

Sergeant First Class Westover served as an engineer platoon observer/controller at the Joint Readiness Training Center, Fort Polk, Louisiana, from 1994 through 1996.

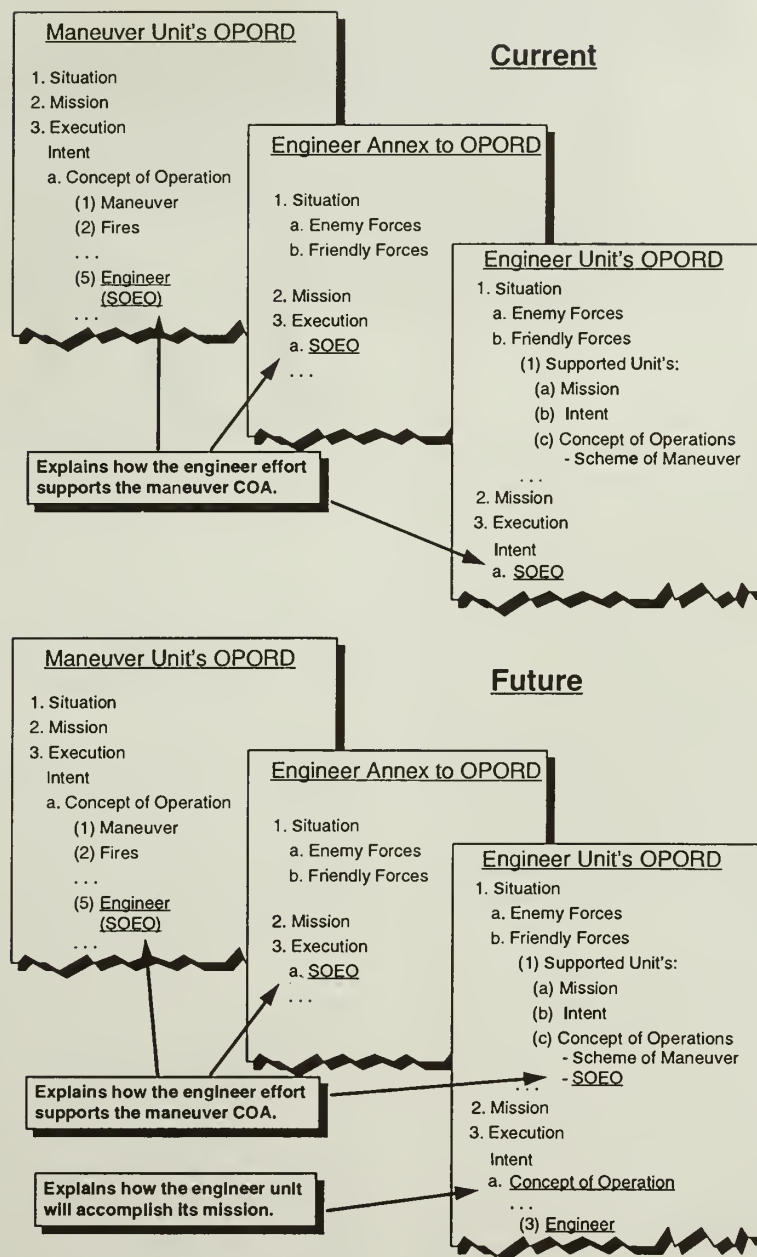
Change 1 to FM 5-71-2/3

By Captain Joe Birchmeier

Small-group instructors at Fort Leonard Wood and observer/controllers at the National Training Center have identified a problem with the format of engineer unit operations orders (OPORDs) in Appendix B of FM 5-71-2, *Armored Task Force Engineer Combat Operations*, and Appendix D of FM 5-71-3, *Brigade Engineer Combat Operations (Armored)*. The problem is that the current engineer unit OPORD format does not allow engineer commanders to fully explain how their unit will accomplish its mission, especially in offensive operations in which the engineer commander is the breach force commander.

Changes. To correct this problem, change 1 to FM 5-71-2/3 will soon be published. The changes include:

- Moving the "Scheme of Engineer Operations (SOEO)" from paragraph 3 to paragraph 1 in both the engineer battalion and company OPORDs. The SOEO focuses on what the essential mobility/survivability tasks are and how they support the Scheme of Maneuver.
- Adding a "Concept of Operations" subparagraph to paragraph 3 in both the engineer battalion and company OPORDs. This change will allow commanders to fully detail how their unit will accomplish its mission. At a minimum, this paragraph will clarify the purpose of the mission, expand on the commander's intent, and describe the commander's plan to maneuver his unit during the operation. The format of this paragraph will be much less restrictive than the SOEO, allowing commanders to tailor the content to their mission.
- Publishing the same SOEO in three documents: paragraph 3.a. of the supported unit's OPORD,



paragraph 3.a. of the Engineer Annex to the supported unit's OPORD, and paragraph 1.b.(c) of the engineer unit's OPORD.

Timeline. Change 1 to FM 5-71-2/3 should be completed and posted on the Internet (Engineer School home page) by the end of April 1997. Paper copies of the changes should arrive in

units through normal publications distribution by the end of the year.



Captain Birchmeier is a doctrine writer in the Directorate of Training and Doctrine, U.S. Army Engineer School. He previously served on the Sidewinder 12 Team, National Training Center, Fort Irwin, California.

From Sandbags to Computers:

What's New in Field Fortifications and Protective Structures

By Colonel Bruce K. Howard

Fortifications have been an integral element of defense throughout the history of warfare. In the past, huge structures were erected to deter enemies and protect the homeland. The Great Wall of China and a multitude of castles throughout Europe are lasting monuments of this doctrine. As armies became more mobile, massive static defensive fortifications became dinosaurs when "modern" armies destroyed them in place or simply bypassed them. The ill-fated Maginot Line is a glaring example of this archaic strategy. Built before World War II to protect the eastern border of France, this defensive fortification was easily outflanked by German invaders.

The art of fortification has been ignored recently, because tacticians thought mobility and modern weapons would make static fortifications passé. This thinking was reinforced by force structure reductions and promises that technology would reduce the need for soldiers and, thus, their protection. Reality, however, tells a different story. Weapons and their threat have increased both in effect and form—from precision-guided munitions to a hodgepodge of terrorist weapons. Though the definition of *static* may have changed (to days or weeks instead of years), the requirement to erect structures to protect our soldiers and equipment is greater now than ever.

The Army's enhanced mobility allows soldiers and units to cover much larger areas of terrain. The need to protect these dispersed assets continues, yet the materials and methods "to protect on the move" have lagged behind other military technologies. Research and development are now catching up with doctrine to provide commanders the necessary, expedient tools to protect their personnel, equipment, and sup-



Soldiers shovel sand into the first layer of a sand-grid revetment. Collapsed sections of sand grid are shown on the ground to the right.

plies. While the soldier-intensive sandbag was the staple for expedience for many years, new materials and methods provide vastly better protection with significantly less manpower.

One of the leaders in this renaissance is the U.S. Army Engineer Waterways Experiment Station (WES). For almost 50 years, WES has conducted blast and weapons-effects tests, from small arms to some of the world's largest nonnuclear blast events. The Department of Defense designated WES the lead research and development laboratory for survivability and protective structures under the Defense Reliance Plan. Much of the information in FM 5-103, *Survivability*, came directly from WES research.

More recently, WES research efforts have moved into new areas:

- Simple, lightweight construction materials.
- Computer programs to assist combat engineering decisions.

- Retrofitting structures to withstand the increasingly violent threat of terrorism.

WES provides research support, products, and answers to our military forces and other government agencies. Using both scale-model blast events and the massive computing power of two on-site supercomputers, WES has advanced the understanding of weapons and blast effects on structures to new levels. The following information profiles some recently developed products and evolving technologies that will enhance protection for soldiers and their equipment.

Sand Grid

Sand grid was the first of a series of quick, effective construction materials developed and fielded to engineer units. Though initially developed to provide soil stabilization on beaches, roads, and shallow river beds,



Two soldiers expand a section of Concertainer. A double-stacked section is in the foreground.

it was quickly adapted to provide protection for personnel and equipment.

Sand grids are made from high-density polyethylene plastic strips welded together to form honeycomb sections. A 3-foot by 20-foot expanded section of grid weighs 45 pounds and has collapsed dimensions of 4 inches deep, 8 inches wide, and 55 inches long. Notched grids allow stacked layers of grid material to lock together and provide fill confinement for revetment construction.

Sand-grid construction is an efficient and cost-effective method of providing expedient protection from the blast and fragmentation effects of conventional weapons. Sand-grid revetments with soil fill provide protection from small-arms fire up to .50-caliber and from the blast and fragmentation of artillery and mortar rounds detonating as close as 5 feet. Evaluations using light antitank weapons and rocket-propelled grenades show that sand-grid revetments with crushed-rock fill provide adequate protection for light armored vehicles and structures.

The life expectancy of sand-grid protective positions far exceeds those built with traditional sandbags. Sand-grid revetments have stood up to two years, showing no effects other than settling of the fill material. When protection is no longer required, sand grids can be picked up, collapsed, and reused at another site. Sand-grid material has

many protective applications and has already been used to construct—

- Protective positions for artillery.
- Load-bearing walls for command post bunkers.
- Protective barriers for ammunition supply points.
- Revetments for petroleum, oils, and lubricants (POL) storage.

Sand grid is available through normal procurement procedures. The national stock number is 5680-01-363-8724 (notched sand grid for revetments). Or order from the General Services Administration by specifying Presto Products Part Number NGW3208 (notched wall grid, in black, green, or tan).

Hesco Bastion Concertainer

A British product called the Hesco Bastion Concertainer Revetment System is another expedient protective system that was recently evaluated and fielded. "Concertainer" is a geocomposite construction material that, when expanded from its shipping configuration, forms a wall section of linked, self-supporting cells. These cells can be filled with earth or rubble to provide ballistic and blast protection from a variety of direct- and indirect-fire munitions.

After expansion, the typical Concertainer wall section is about 4.5 feet

high, 3.2 feet wide, and 33 feet long. The sections can be stacked two high and spliced together to form walls of various lengths. When empty, each section weighs 300 pounds. Two soldiers can erect and prepare the wall sections for filling with on-site materials. The Concertainer protective system provides better protection with far fewer assets than sandbags or other materials and can be used at fuel points, helipads, artillery/mortar positions, and vehicle barriers. The Hesco Bastion Concertainer Revetment System, which is less expensive than other expedient protective measures, has been exceptionally successful in Bosnia.

Units may order Concertainer through normal procurement procedures. National stock numbers vary depending on the length, width, height, and color of Concertainer needed.

Multipurpose Protective Shelter

Even though the Army's mobility and armaments continue to improve, our need to "dig in" remains. Deployments take us to areas where the weather, terrain, and/or available materials make soldier protection difficult, time consuming, and often inadequate. Instead of using layers of sandbags for protection, soldiers can use Multipurpose Protective Shelters. They will help alleviate shortages of construction materials, save time and



The corrugated aluminum pieces of the shelter fit together quickly.



A completed Multipurpose Protective Shelter. The sand-grid overlay provides additional protection and soil stabilization.

resources, and provide vastly better protection than sandbags.

The shelters consist of individual pieces of corrugated aluminum that fit together quickly. Layered with soil, they are safer and less susceptible to weather than a shelter made with sandbags. The shelter package weighs 550 pounds without end walls and can be erected in single or multiple units. A single unit is approximately 13.3 feet long, 9.1 feet wide, and 7.4 feet tall. When no longer required, it can be dismantled and trans-

ported to a new site. The fighting position is reusable, interchangeable, and provides protection from a variety of direct and indirect munitions.

The Multipurpose Protective Shelter has been successfully evaluated by the 326th Engineer Battalion and the 555th Engineer Group. Specifications were sent to the Engineer School in FY96, and the information will be incorporated into Army field and technical manuals when they are updated. Shelter components may be purchased as standard construction materials.

Simplified Survivability Assessment

Many methods of fortification enhance the soldier's protection, but how and when to use each method is more difficult to recognize. WES is developing a Windows-based Simplified Survivability Assessment software program to help engineers predict and prioritize the resources required for various levels of survivability. The assessment procedure will help determine the type of protection, the materials, and the construction manpower required; the resultant level of survivability provided; and the time needed to achieve that level. The software will produce construction drawings for representative protective structures and a materials price list.

The software also allows engineers to design roof support structures and determine the depth of soil needed to cover the structure, based on the threat weapon. The assessment procedure determines the best structure design to protect soldiers and equipment and shows how to upgrade a structure to accommodate increased threat levels.

XVIII Airborne Corps units are field testing this software. Initial tests were very successful, and a prototype should be available through the Engineer School in late 1997.

Damaged Buildings

The Army's increased mobility and maneuver speed allow soldiers little time to build field fortifications, so they often occupy existing structures. Many of these buildings are damaged in combat, as occurred during Operation Joint Endeavor. Often, it is difficult to determine which buildings are safe or provide adequate protection.

The *Building Assessment Handbook*, a user-friendly, step-by-step guide for making rapid building-safety assessments, was developed to address this

“Engineers often are faced with the challenge of providing expedient protective measures.”

need. Using figures in the guide, combat engineers can analyze key components of a structure to determine a rating for the building. Completed analyses allow engineers to rate a building as “Apparently Safe,” “Limited Entry,” or “Unsafe.” This guide enables engineers to focus their attention on required repairs or construction, allowing the troops to prepare for the next operation in safe accommodations.

The guide was originally a “quick fix” that provided minimal criteria for soldiers to evaluate damaged structures and develop rough repair estimates. A Windows-based software program is being developed to assist in selecting and retrofitting existing buildings. The latest prototype is scheduled for distribution to selected field units in FY98.

Antiterrorism Planner

Though our forces are more mobile, many support facilities remain static and are vulnerable to terrorist or long-range threats. These facilities must be protected so our support structure remains viable and the soldiers and civilians who work there are safe. WES is developing an Antiterrorism (AT) Planner to help engineer officers plan and implement optimum protective measures.

The demand for military engineering to support antiterrorism rose dramatically as the Army was drawn into a succession of operations other than war. In these situations, our soldiers are subject to attack by unfriendly civilian or paramilitary groups. The

AT Planner is a Windows-based software program that operates on a notebook computer. It draws on completed and ongoing research related to protecting fixed facilities from terrorist attack as well as research on field fortifications.

The AT Planner will provide engineers a computerized analytic capability to evaluate critical assets in terrorist threat scenarios based on aggressors, tactics, and weapons systems. The threat conditions dictate several security measures from FM 5-114, *Engineer Operations Short of War*, that engineers must consider and possibly employ. These measures are cumulative from the lowest to the highest threat level and are presented in a concise and user-friendly format. Emphasis is placed on evaluating structures that can be classified as habitable or as warehouses. Structural components are defined for frames, walls, and roofs. Damage is calculated using algorithms from the Facility and Component Explosive Damage Assessment Program, with the user providing the distance of the explosive charge from the building.

The system will facilitate the analysis of mission requirements and constraints, including the level of protection required and the time and resources available. Protective measures will include vehicle barriers, blast protection, and protection from shoulder-launched weapons and small-arms fire.

Initial troop evaluations of the AT Planner will begin in May 1997. It will be provided to the Engineer School for distribution at the end of FY98.

As new materials (such as high-strength concretes) are developed, their

benefits will be incorporated into the software. Commanders will use the AT Planner to calculate the correct level of protection needed to counteract any threat.

Conclusion

Although the size and shape of field fortifications have changed considerably through history, the need for protection today has increased as the lethality of the threat continues to escalate. Engineers often are faced with the challenge of providing expedient protective measures. New materials and methods being developed will help engineers protect our forces. These new materials and design tools will provide better, more cost effective, and quicker protective measures for our soldiers and assets worldwide. We must field and train with these improved products so our soldiers do not fill the ubiquitous sandbag in a “Magenot Line” of the future.

For additional information on these and other WES research and development projects, check the Worldwide Web at <http://www.wes.army.mil> or write to Commander, U.S. Army Engineer Waterways Experiment Station, 3909 Halls Ferry Road, Vicksburg, Mississippi 39180-6199.



Colonel Howard is commander of the U.S. Army Engineer Waterways Experiment Station. He is a graduate of the Command and General Staff College and the Army War College and has a master's degree in environmental engineering from the University of Florida.

EOBC Gets a New Look

By Lieutenant Colonel Ted A. Thomas

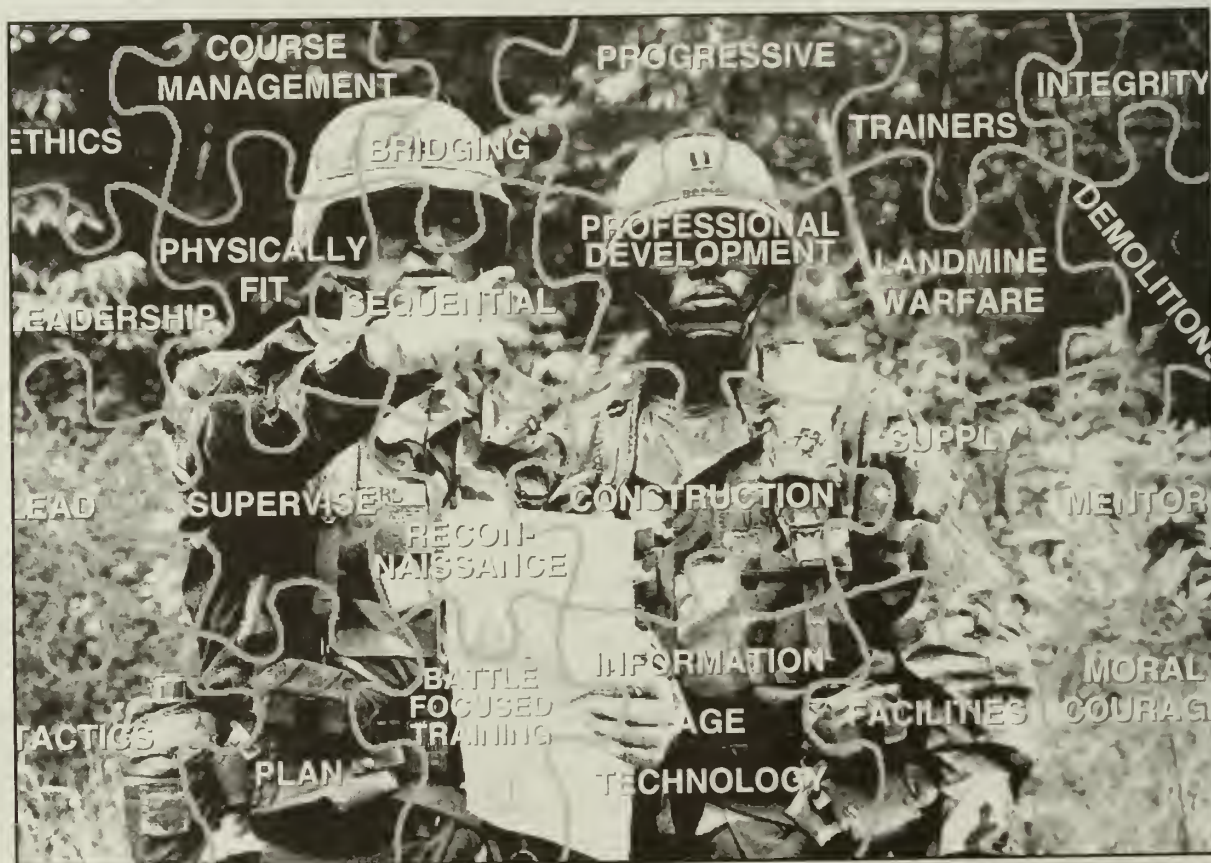
Maneuver commander: "Hey, engineer lieutenant! I need your help in upgrading some roads and building some shelters."

Engineer lieutenant: "Sir, I'm a combat engineer, not a construction engineer. I'm not trained to do those tasks."

Beginning in May 1997, the Engineer Officer Basic Course (EOBC) will have some fairly significant changes. In line with the current *One Corps, One Regiment, One Fight* concept, the Engineer School will train all engineer lieutenants to be engineers, not "combat" or "construction" engineers, and they will all com-

plete the same program of instruction (POI). With this new training, all graduating lieutenants soon will be able to respond positively to their maneuver commanders' requests for assistance.

The 554th Engineer Battalion and the Engineer School have eliminated the two-week split in training focus between lieutenants going to combat heavy assignments and those going to combat battalions. Until now, both the construction track and the combat track were two-week classes. Rather than require all students to complete both tracks, which would extend EOBC from its current 17 weeks to 19 weeks, redundant training was eliminated and some classes were shortened.



"The Engineer School's goal is to produce the best-trained lieutenant it can in 17 weeks."

Major Changes

Comments and after-action reviews from the field and the combat training centers resulted in many of the following changes to the EOBC:

- Increased leadership training from 6 to 24 hours
- Added a terrain visualization/obstacle integration training exercise without troops (TEWT) (8 hours)
- Added a task force engineer practical exercise (8 hours)
- Added offensive and defensive tactical reconnaissance classes (4 hours)
- Added force-protection construction training (2 hours)
- Added military operations in urban terrain training (3 hours)
- Integrated tactics and combat engineering training (5+ weeks)
- Converted the Project Hammer exercise from a 3-day construction project to a 2-day project-inspection exercise
- Reduced geotechnical training from 26 to 18 hours
- Consolidated exams, saving 8 hours
- Eliminated the medium girder bridge and ribbon raft construction project
- Changed the Army Physical Fitness Tests from weekdays to Saturdays

Training Sequence. In the revised EOBC, each platoon will have the same training sequence throughout the

year. Currently, the course is taught in modules because there are normally two or three platoons in each class iteration but not enough instructors to teach all of the platoons the same subject concurrently. Since each platoon has a different sequence of instruction, the modules are independent packages and do not rely on previously taught material. To remedy this problem, there will be nine platoon-sized EOBC classes per year, each consisting of about 60 soldiers. This schedule allows the course to follow a logical sequence and build on prior knowledge, facilitating better learning.

The nine classes per year support the schedule projected for the Maneuver Support Center. The Military Police and Chemical Schools have seven classes per year in their basic courses. Seven of the EOBC classes will align with theirs, allowing the three schools to share training during inprocessing and soldierization, as well as the common core instruction. The EOBC field training exercise will move to the 12th and 13th weeks of the course to coincide with the other schools' field training exercises.

Terrain Visualization/Obstacle Integration TEWT. The Joint Readiness Training Center (JRTC) and the National Training Center (NTC) noted that obstacles usually are not employed or sited properly within the commander's intent. The new TEWT requires lieutenants to build an engagement area by envisioning it from the enemy side, noting its intervisibility lines, determining the types of obstacles to emplace and where to emplace them, and coordinating these activities with a maneuver commander. A maneuver officer from the Engineer School's Department of Tactics, Lead-

ership, and Engineering will assume the role of maneuver commander.

Task Force Engineer Practical Exercise (PE). This exercise was added to the curriculum because of JRTC comments. In 1989, the EOBC shifted its primary focus to the engineer restructure initiative (ERI), leaving out the light community. The new PE teaches the planning and coordination skills needed across the full spectrum of engineer assignments. Under the ERI concept, company executive officers are heavily involved in the task force engineer mission. The task force engineer PE consists of orders process instruction—going through the deliberate decision-making process, developing and evaluating courses of action, and participating in wargaming and synchronizing the engineer effort in combined arms operations. This instruction will benefit all lieutenants, regardless of their assignment, but it will be especially valuable for those going to light divisions.

Combat Engineering and Tactics Training. Module sequencing will allow a seamless transition from combat engineer training to tactics training. Currently, these subjects are taught as independent, stand-alone blocks of instruction. In the revised EOBC, they will be introduced in a logical sequence. For example, when instructors teach the fundamentals of land mines (such as the M21 antitank mine), they will describe how mines are armed and used in a minefield; then they will explain why and how minefields are used in tactical operations.

Project Hammer. This exercise will focus on platoon leader responsibilities rather than performing carpentry, plumbing, and wiring projects. Lieutenants will learn about blueprints, bills of

material, material takeoff lists, and quality assurance and inspection procedures. When engineers from light units deploy to undeveloped countries such as Somalia and Haiti, they are often among the first soldiers on the ground. They need engineer construction skills to build base camps, provide waste disposal, upgrade or build main supply routes, and perform many other engineer-related tasks. To fill that need, all engineers will receive the training required to perform their missions during operations other than war.

Conclusion

The Engineer School's goal is to produce the best-trained lieutenant it can in 17 weeks. Although these young officers cannot become experts in all the subjects taught at the school, they will receive a broad range of training opportunities and experience. This will be a tremendous advantage when they arrive at a unit. Lieutenants leave the basic course excited about being an Army officer and eagerly look forward to leading a platoon and serving their country. It then becomes the unit's responsibility to sharpen their warfighting and leadership skills. These young officers are the future leaders of the Engineer Corps. Soldiers are our credentials, but our junior leaders are our legacy.

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(Personal Viewpoint, continued from page 12)

obstacles that will allow him to disengage when he chooses. Wide dispersion will negate the already difficult concept of shifting engineer units across task forces to support multiple operations.

At the same time, maneuver units will be faced with an increasingly complex array of countermobility threats. Among these are the use of mines and other obstacles in great number, plus better use of the terrain's natural countermobility effects, to asymmetrically combat American superiority in speed and firepower. Land mines are a cheap, deadly, and almost-insurmountable threat to the mobility of U.S. forces. The problem will get worse as more countries acquire a dynamic obstacle-emplacing capability by using systems equivalent to our Volcano and artillery- and helicopter-delivered scatterable mines. The lesson of Desert Storm will be very clear to our enemies: The American Army cannot be allowed to freely maneuver its armored forces.

Even the nature of the threat will pose an increasingly difficult problem. The mountains of Bosnia and Iran, the ricefields of Korea, the jungles of Africa and South America, and urban sprawl everywhere are certainly more challenging to our mobility than the north German plain or the Iraqi southern desert.

Despite *Army Vision 2010*'s claim that the Army is the service of choice to ensure full-spectrum dominance, divisions become less capable of full-spectrum operations with the loss of an engineer battalion. Combat engineer battalions often are the unit of choice in operations other than war. They deploy as mechanized infantry when Bradleys are inappropriate, as firefighters, and as relief for all kinds of disasters. In all operations (garrison, combat, and operations other than war) TRADOC's Division XXI design will result in a huge increase in operational tempo and personnel tempo for the two engineer battalions.

While the basic organizational

structure of an engineer brigade and three battalions remains sound, heavy division engineer battalions still need major internal changes to meet the rigorous requirements of both today's and tomorrow's battlefields. Clearly, we must resource key staff officers such as the S2, signal officer, and maintenance officer; restructure the maintenance section to provide company-oriented contact teams; and provide a desperately needed organic medical evacuation and treatment capability.

Focus on Success

The 299th Engineer Battalion in the 4th Infantry Division's experimental force has worked diligently to improve the battalion's capability by using recent lessons learned and future warfighting concepts. The differing approaches taken by TRADOC and the 4th Infantry Division are extraordinary: One whittled away at an old structure to arrive at a predetermined manpower cap, while the other focused on warfighting and improved capabilities.

Deletion of an engineer battalion from the division structure does indeed save personnel spaces, but it creates a poor warfighting design. It repeats mistakes of the past. It fails to capitalize on lessons learned, recent innovations, and battle-proven structures. It fails to address the challenges of the future. It is the wrong force design for the Army's division of the 21st century. The Army needs to reinforce, not destroy, the successes of today's heavy division engineer brigade.

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UNIFIED ENDEAVOR 97-1

JOINT TASK FORCE STAFF ENGINEERS

By Captain Calvin Hegeman

The leader of a foreign country has abruptly left office, creating instability in the region. The U.S. government is very interested in maintaining peace in order to protect U.S. personnel and property. In response, Joint Task Force (JTF) 780 is formed for "Operation Unified Endeavor 97-1." The mission is to deter or, if deterrence fails, enforce peace to protect U.S. interests.

This scenario-driven computer simulation is performed at U.S. Atlantic Command's (USACOM's) Joint Training, Analysis, and Simulation Center (JTASC) in Suffolk, Virginia. The JTASC offers a unique technical infrastructure for conducting realistic joint task force exercises. It has a full array of high-tech resources, including state-of-the-art computers, large display screens, secure telephones, and audiovisual and interactive video teleconferencing systems for use internally and externally.

The series of Unified Endeavor exercises was developed in

1995 to train potential JTF commanders and their staffs to respond to crises in a realistic joint environment using computer-driven simulation. The cost per exercise is about \$3 million—substantially less than the approximately \$40 million it costs to conduct a large-scale, multiservice field exercise.

XVIII Airborne Corps was the JTF headquarters for Unified Endeavor 97-1. The exercise was conducted in three sequential phases over a three-month period from September to December 1996.

Phase I involved one week of classroom instruction. Staff and general officers gained an academic foundation in joint doctrine, tactics, techniques, and procedures. The seminar emphasized joint lessons learned and current and emerging issues in joint operations.

Phase II was a 2-week crisis action planning session involving more than 300 personnel from joint planning sections. After



The Joint Training, Analysis, and Simulation Center (JTASC) located in Suffolk, Virginia, is USACOM's automated JTF training center.

receiving the scenario and the operations order from USACOM, the JTF staff began the deliberate decision-making process. The staff then presented the JTF Operations Order and a finalized Time-Phased Force Deployment Database (TPFDD) that shows the timing and movement of military forces into the area of operation.

Phase III is Unified Endeavor's execution phase. The JTF implements the operations order in response to scenario events generated via advanced computer simulation models. Leaders and staff respond to changing circumstances that place the events in all ranges of the operational continuum—peacetime, conflict, and war. For this exercise, success meant to—

- Avoid going "kinetic," the term used for full combat operations.
- Develop "triggers," which are certain enemy actions or events that tell the commander a pre-emptive strike is necessary.

The early focus on operations other than war and deterrence missions adds credibility and legitimacy to the exercise. A full range of political and diplomatic decisions influenced military decisions throughout the operation. Information warfare is a key focus during Unified Endeavor exercises, and participants take media and world opinion into account. For instance, frequent press conferences are held and televised throughout JTASC. Anyone caught walking in the hallway may be asked by simulated reporters for an interview. Later that evening, the interview is broadcast on the Unified Endeavor News Network, a simulated news program.

Today's military actions are most likely to be contingency operations, whether they are combat operations or operations other than war. JTF doctrine is still evolving, and engineers must be part of this evolutionary process to ensure that they are postured to provide unity of effort and mission accomplishment for future contingencies.

The XVIII Airborne Corps Staff Engineer Section and personnel from other services manned the joint engineer cell during the exercise. The following considerations, compiled by the cell and the USACOM engineer observer/trainer, should improve efficiency for future joint engineer cell operations.

Joint Engineer Cell Component

Understanding how other component engineers function and their mission and equipment is important for a smooth-functioning organization. The Navy, Marine Corps, Air Force, and Army engineer units have specific skills that—once understood by the JTF engineer and his staff—can be used to their fullest potential. This is especially critical during Phase II, when the Joint Planning Group is developing courses of action. Each course-of-action planning group should include an engineer who is familiar with the capabilities of each service.

NAVFOR. Navy engineer support consists of one naval mobile construction battalion (NMCB) with 726 personnel. The NMCB can quickly deploy to force-projection theater locations to construct and improve naval facilities. The NMCB's main mission is to provide responsive military construction support, conduct

battle damage repair operations (including rapid runway repair), and construct base facilities. Other missions include constructing rotary-wing airfields; airfield support structures; petroleum, oil, and lubricant systems; ammunition supply points; and lines of communications.

The NMCB can provide an air detachment that deploys by strategic airlift within 48 hours. The air detachment, a lead element of the NMCB, is composed of 91 personnel. The detachment repairs immediate war damage and constructs projects urgently required by major operational plans. For many construction missions, only an air detachment needs to deploy.

MARFOR. Marine air ground task forces (MAGTF) are integrated combined arms forces structured to accomplish specific missions. The Marine expeditionary force (MEF) is the principal Marine Corps warfighting organization. It ranges in size from less than one to multiple divisions and aircraft wings, together with one or more force service support groups. An MEF is self-sustainable for up to 60 days but may be deployed longer with external support.

The Marine engineer mission is based on the way the Marine Corps fights—as a task-organized MAGTF consisting of four elements. Each element has organic engineers, who provide mobility, countermobility, survivability, and general engineering support.

Command element (CE) engineers serve as special staff officers to the MAGTF commander. They are responsible for coordination between the subordinate element engineer units and external elements.

Ground combat elements (GCE) range in size from a battalion to one or more divisions. Marine engineers and their assets in the GCE are sourced from the combat engineer battalion (CEB) organic to the Marine division. Division engineers primarily exist to support the maneuver of the GCE. Their missions include engineer reconnaissance, assault breaching, bridging, and demolition. They also provide limited general engineering support to the division.

Aviation combat elements (ACE) vary in size from one aircraft squadron to one or more wings. Engineer assets organic to the ACE are in the engineer operations divisions, which are located in four Marine wing support squadron (MWSS) units of the Marine wing support group (MWSG). Wing engineer missions include constructing, maintaining, and improving expeditionary roads, base camps, drainage systems, and vertical and short takeoff and landing sites. They also assess bomb damage and provide rapid runway repair.

Combat service support elements (CSSE) draw engineers from the engineer support battalion (ESB) organic to the force service support groups. The ESB provides expeditionary general engineering support and engineer combat service support for the entire MAGTF. An ESB consists of a bulk fuel company, a headquarters and service company, an engineer support company, a bridge company, and three engineer line companies.

AFFOR. Air Force engineers are organized into three basic types of units:

RED HORSE (rapid engineer deployable heavy operational repair squadron) squadrons are mobile, self-sufficient, and

organized by regional responsibility. They can construct facilities for major force bed down, repair extensive damage, develop bases, and perform heavy engineering operations. RED HORSE squadrons are the lead joint engineer resource for force projection. Their missions are solely wartime related. RED HORSE squadrons form three types of deployment echelons.

RH-1 Echelon. This 16-person team deploys within 12 hours and prepares for the reception of follow-on RED HORSE elements. The team performs advance airfield surveys, including evaluations and assessments of airfield pavement, water supplies, utility systems, and existing facilities. It prepares a bed-down plan for establishing a force-projection base and compiles a list of materials required to accomplish the plan.

RH-2 Echelon. This 93-person element can deploy within 48 hours with heavy equipment capable of clearing land, stabilizing sites, performing drainage earthwork, and erecting structures essential for force bed down. This element also can perform rapid runway repair and repair bomb-damaged facilities and systems. It provides initial civil-engineering support, including well drilling.

RH-3 Echelon. This 295-person element can deploy within 6 days. It can repair heavily bombed areas and construct facilities, including expanding essential utility systems, power generation systems, heavy earthwork, and concrete operations.

Prime BEEF (base engineer emergency force) units are organized as combat support squadrons and teams. They are assigned to all major Air Force bases to provide peacetime civil-engineering and maintenance support. A large-scale Prime BEEF combat support squadron can be organized into eight types of combat support squadrons to support theater requirements. These squadrons can fully support AM-2 matting and concrete-slab rapid runway repair operations. Small specialty teams can be organized into nine teams of 3 to 48 personnel, with varying compositions to fit the mission. Skills in a specialty team range from fire fighting to construction management or whatever staff augmentation is necessary to fill known requirements.

Prime RIBS (readiness in base support) units provide combat morale, welfare, and recreation support.

ARFOR. The Army engineer organization may consist of several different packages to support the JTF commander. Engineer combat battalions perform mobility, countermobility, and survivability missions. Each battalion is structured to support a specific Army division and is organized as either light, air assault, airborne, or mechanized to support that division. Divisional engineers have limited construction ability.

The following units are most likely to be used for contingency engineer operations:

Engineer combat battalions, corps are organized as either airborne, light, wheeled, or mechanized units. The units perform horizontal, vertical, and combat engineering missions. They are designed to augment division assets and support corps rear operations.

Engineer combat battalions, heavy construct and maintain facilities and lines of communication and assist in preparing protective positions. Tasks include constructing and repairing

airfields, command posts, main supply routes, and critical facilities.

Engineer battalions, prime power provide electrical power. They have two teams: power plant teams operate electrical generators, and power line teams construct and maintain up to 60 miles of high-voltage electrical power lines.

Engineer companies (combat support equipment) perform horizontal construction and sustainment engineering. They are self-supporting and include maintenance, mess, and administrative sections.

Engineer companies (assault float bridge) (ribbon) construct floating bridges up to 210 meters long for crossing traffic up to military load class (MLC) 70. For gaps longer than 210 meters, they conduct rafting operations to reduce the load capacity to MLC 60 traffic.

Engineer port construction companies develop and maintain port facilities. They construct and maintain piers, wharves, ramps, and related structures required for loading and off-loading cargo.

Engineer companies (topographic) conduct topographic and geodetic surveys and terrain analysis and reproduce maps. In a JTF operation, one or more companies may support the JTF headquarters to provide terrain analysis products and tactical decision aids.

ARFOR engineers may also provide salvage diving, well-drilling, surveying, and fire-fighting teams to the JTF.

Organization

A joint task force engineer cell includes officers and non-commissioned officers from each of the services involved. The cell organized for Unified Endeavor 97-1 was located under the J3 (Figure 1, page 38). The organization is tailored to fit the mission and meet the commander's intent.

Traditionally, the engineer cell was located under the J4. This alignment may be effective in JTF operations requiring primarily civil engineering skills. When engineers are needed to conduct combat operations, it is more practical for the engineer staff element to fall under the J3.

Ideally, the engineer cell should be established as a separate staff element. Joint engineer operations are intertwined throughout the joint operational area and range from repair of critical facilities to combat operations. Also, engineers are networked to several sections of the JTF staff. They are part of the J5 planning group, J3 operations, J2 terrain analysis (including battlefield visualization), and J4 infrastructure repair and development (Figure 2, page 38).

The Joint Operations Cell (JOC) is the heart of the JTF staff. The JOC in JTASC is located in a movie-theater-sized room with three large screens in front and networked computers on every desk. All situational updates and operational decisions flow to the JOC, which includes operations and liaison officers from all sections and services of the staff and the components. The engineer operations officer, also located in the JOC, passes information to the engineer cell so timely decisions can be made. Having an engineer liaison officer in the JOC is not part of current doctrine; however, it benefits joint engineer cell operations.

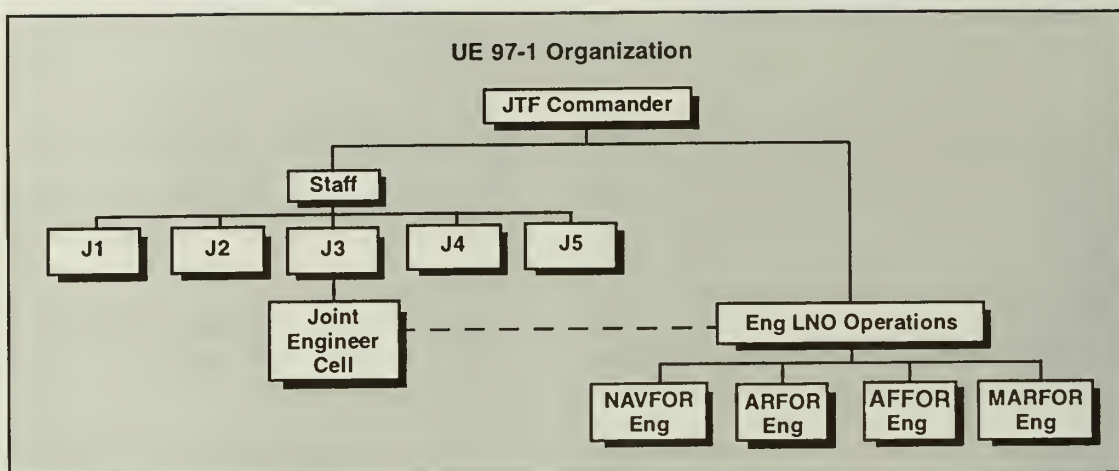


Figure 1

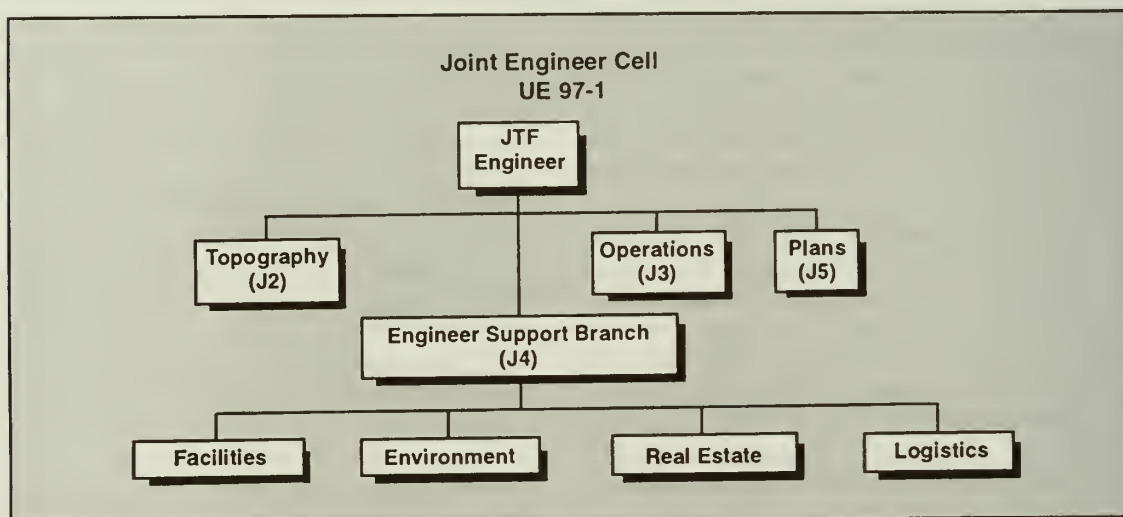


Figure 2

Explosive ordnance disposal (EOD) is not an engineer mission in the Army, although it is in the Air Force and the Marine Corps. During Unified Endeavor 97-1, the joint engineer cell was responsible for writing the EOD annex for the JTF operations order. No EOD section was created within the joint engineer cell, but EOD issues were handled throughout the engineer staff. In the future, EOD should have a staff section located in the J4 with representatives from each service. The alternative is to leave EOD as an engineer mission and add EOD personnel to the engineer manning roster.

The engineer cell topographic section provides many products for the JTF staff. One topographic team cannot provide all the products requested, so a minimum of two teams should deploy—one located with J2 Intelligence and the other in the joint engineer cell. The Marine Corps terrain teams are experts in beach topography and are required if a beach assault is part of the plan. The team has additional terrain data that can be cross-referenced with Army data to augment the picture of the operational area. Due to budget reductions, the Marine terrain team did not participate in Unified Endeavor 97-1.

Engineering Boards

The joint engineer cell is responsible for coordinating three boards:

- *The Joint Civil-Military Engineering Board* provides oversight by establishing policies, procedures, priorities, and overall direction for civil-military construction and engineer requirements.
- *The Joint Facilities Utilization Board* manages facility requirements. It evaluates and reconciles use of facilities, real estate, interservice support, and construction.
- *The Joint Environmental Management Board* establishes policies, procedures, priorities, and direction for environmental management. It includes personnel from joint staff, components, engineer units, host nation representatives (if applicable), other government agencies, and contractors.

It is important to decide early who will attend these boards and the meeting time and place. For the Unified Endeavor exercise series, consider holding one or more of these boards during Phase II. Phase III is very fast-paced, and it becomes increasingly difficult to gather the necessary personnel to attend. Consider holding more than one board simultaneously, because many of the attendees are on several engineer boards.

Automation

The JTASC is a unique building, with outstanding automation and communication platforms. The primary means of communication within the JTASC is e-mail and newsgroups. For example, once a fragmentary order is approved, it is placed in a newsgroup file. Anyone in JTASC can access the file, read it, and then store the information on their computer's hard drive. This streamlined system almost eliminates paper copies for distribution, saving time and supplies. However, considerable time was spent learning how the information flows and how to capture and catalog it for future use.

The software package used for Unified Endeavor 97-1 was *Netscape Navigator* for newsgroups and *Eudora Pro* for e-mail. Newsgroups became a cyberspace dumping ground of information, with hundreds of files. An operator worked full-time to read newsgroups, decipher what was relevant to the engineer cell, then e-mail the information to the appropriate staff members.

The preferred communications system used the "push-pull method." In theory, if someone created a document that was important for another cell, we "pushed" it to them via e-mail. That same document was also posted on newsgroups. If another cell wanted the document, they "pulled" it from the newsgroup engineer file. Not everyone used the push-pull method. Some important information was placed in newsgroups, and it was up to the cell to locate it. As a result, much information was not read. Everyone on the engineer staff should be experienced with computers and the software used during the exercise.

Global Command and Control System

The Global Command and Control System (GCCS) is a powerful new system that replaces the Worldwide Command and Control System. GCCS uses a secured Internet connection to provide a user-driven, widely distributed view of military operations. All government and military agencies can use this system to transfer and store secret data worldwide in a near real-time environment. The Secret Internet Protocol Router Network provides connectivity between GCCS sites.

Seven GCCS terminals located in the JOC were used to access information on—

- Enemy weapons systems.
- Enemy engineer equipment (with photographs).
- World weather satellite photographs.
- Current positions of friendly military units.
- Location of airports and landing strips worldwide.
- Intelligence updates from national assets.

GCCS includes a Netscape browser with limited interactivity to the Worldwide Web. Within the GCCS environment, each command center has its own home page with links to other command centers and other vital information. Netscape

is a powerful program used to access this information. The GCCS version of Netscape is similar to the civilian version, making this system relatively user friendly.

The GCCS contains the Joint Engineer Planning and Execution System (JEPES). This planning tool helps the commander in chief and the service components determine the civil engineering support requirements and document their civil engineering support plan. The JEPES program extracts unit and personnel data from the TPFDD and factors in facility planning data. Then it subtracts existing facilities and computes the total facility requirements. JEPES also generates reports and graphics to illustrate requirements and provides data for Logistics Sustainability Analysis and the Logistics Sustainment Analysis and Feasibility Estimator System.

USACOM conducted a one-week GCCS user's course prior to Phase II of Unified Endeavor. GCCS provides a unified and fused picture of the battlespace, bringing joint command and control support capability into the 21st century. The full value of GCCS will not be known until the system is distributed and its capabilities are incorporated into all staff-level operations.

Compatibility

Subordinate components and the JTF staff must use compatible software systems. Presently, II MEF uses Lotus, not Microsoft Office, which makes it difficult to send and receive charts and graphs across the JTF.

Subordinate engineer elements among the components sent different types of situation reports (SITREPs). As a result, much time was spent translating information. A standard JTF engineer report should be developed early and distributed to each of the components. The joint staff J4 is developing a publication for engineers that addresses this issue. In the interim, USACOM engineers have written a standard SITREP, which will be added to the Joint Task Force Standing Operating Procedures.

Conclusion

Unified Endeavor provides a unique training medium. It places engineers from all services into a JTF configuration and teaches them how to conduct joint operations using a real-world mission on real terrain. Engineers use this experience to organize, deploy, and employ Navy, Marine, Air Force, and Army engineer forces during overseas crises. Doctrine and technology continue to evolve, forcing engineers to rethink how to conduct joint operations. USACOM allowed us to test doctrine by providing the most advanced training facility available and then assisting engineers with supportive personnel. USACOM is striving to improve efficiency and productivity for future joint task force contingency operations. Unified Endeavor is an excellent vehicle to accomplish this mission.



Captain Hegeman is currently assigned to the XVIII Airborne Corps Staff Engineer Section, 20th Engineer Brigade, Fort Bragg, North Carolina. He was Chief of Engineer Operations during Unified Endeavor 97-1.



ENGINEER UPDATE

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Engineer Publication. We request your input supporting continued publication of *Engineer*. Due to budget reductions, *Engineer* may be forced to reduce the number of paper copies published and rely more on electronic distribution. Send comments to: Commandant, U.S. Army Engineer School, ATTN: ATSE-TD-D-EB, Fort Leonard Wood, Missouri 65473-6650. Our e-mail address is: eubanksc@wood-vines.army.mil. POC is Cathy Eubanks, -4104.

Engineer Unit Directory. Paper copies of the Engineer Unit Directory will not be printed this year. Instead, the directory has been posted on the Worldwide Web at the following file location: www.wood.army.mil/DDD/ddd.htm. Units not having access to the Internet may request a disc or e-mail copy of the directory. POC is Nancy Baker, -4100.

Engineer Personnel Proponency Office (EPPO)

Changes in NCO Structure (CINCOS). The Vice Chief of Staff initiative to reduce NCO content Armywide from 50 percent to 47 percent has been staffed through the Engineer School and the commandant. The engineer CINCOS proposal forwarded to TRADOC on 15 February 1997 focused on tables of distribution and allowances authorizations and has minor impact on the warfighters. Career Management Field (CMF) 12 has a current NCO strength of 44.1 percent, and our proposal reduces that number to 43.6 percent. CMF 51 may improve slightly from 43.2 to 43.5 percent. Our proposal for CMF 81 reduces the NCO content from 48 to 46.4 percent. All proposed changes are in positions where redundancy exists. The proposal will not reduce advancement opportunities. POC is SGM John Murphy, -4087.

Call for Divers. Are you tired of exploring only one-third of the earth's surface? Are you looking for a physical and mental challenge? If so, the Army needs highly motivated and fully qualified men and women to fill diver (MOS 00B) slots. Soldiers in any MOS may submit applications in accordance with Army Regulations 611-75 and 611-201. If accepted, they will train for three weeks at the prequalification course, Fort Eustis, Virginia, and for 20 weeks at the Second Class Dive School, Panama City, Florida.

Dive training and subsequent duty as a diver present a unique opportunity for motivated soldiers to become members of an elite, mobile organization. Once accepted, candidates will learn underwater fundamentals and have an opportunity to advance as far as their skills and desire will take them. For more information, see your local PSNCO or Retention NCO, or call MSG Parrett, DSN 676-7311. The e-mail address is parrettk@wood-vines.Army.mil. POC is MSG Parrett, -4087.



BRIDGE THE GAP

By Command Sergeant Major Julius B. Nutter
U.S. Army Engineer School

Keys to Retention Success

As the Army works to sustain its 495,000 end-strength force, keeping quality people should be our number one priority. "Performance" was the magic word when selecting quality people for retention. Now we must keep our best professionals—those who are competent and physically and mentally fit and who have high moral and ethical values.

The future may not resemble the past with regard to recruiting and retaining soldiers. Nowhere is it given that the Army will be able to attract and retain the quality, motivated, self-disciplined, and intelligent men and women that it needs. To be successful in a very complex and automated environment, our future Army needs quality soldiers.

Let me share with you some ideas for retaining soldiers. These ideas show a caring leadership environment. Unit leaders can use them to turn ordinary soldiers into extraordinary soldiers and to retain a quality force. They are designed to help leaders keep quality people—those who make a positive difference in mission execution. Use them to help create and maintain an environment in your unit where people want to be, in contrast to a place where they are obliged to be.

Sponsorship is the first step in making a new soldier part of the team. The initial treatment that a new soldier receives upon arrival leaves a lasting impression of the unit. A successful unit sponsorship program should include the following:

- Unit history
- Mission statement
- Mission essential task list (METL)
- Policies and procedures
- Short- and long-term unit goals
- Visit to installation support agencies

Share the unit's goals and vision. It is important for soldiers to understand them. When the mission statement paints a positive picture, it's amazing how sharing the vision enhances commitment, retention, and quality performance.

Bonus tip: At your next command information class, ask if anyone knows what the unit mission is. Some may guess. Some may know. Some may laugh and ask, "Do we really have one?"

Conduct quarterly sensing sessions to get a "feel" for your subordinates' concerns. Ask members the following questions:

- How is the unit doing?
- In what areas can we improve?
- How can we improve on weaknesses?
- Do you see anything that may interfere with your ability to be a real contributor?

Give people room to breathe, make decisions, and make mistakes from which they can learn. Most of all, instill the impression that you respect their judgment.

Note: If you want to build capable people who will stay for more than the short term, let them run with the ball. Trust them enough so they will seek your input when it is needed.

Encourage soldiers to be all they can be through military and civilian schooling. Most soldiers want to be part of a unit that cares about their professional development.

Finally, leaders at all levels must **talk** to soldiers and their families about re-enlistment. Sometimes the best way to retain quality is to ask soldiers to stay on the team. Other times it may take command involvement to get a soldier an option or assignment he or she wants.

This year the Army must recruit 90,000 men and women. Every quality soldier we retain brings us closer to this goal. To reach this goal requires a team effort. I solicit your support.



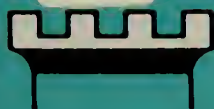
Two American soldiers look down on a long row of "dragon's teeth" (concrete devices to halt invading tanks) at the Siegfried Line. American troops moved through a break in the vaunted defense line and passed into Germany in September 1944.

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August 1997

Panther II



Improving Engineer Mobility

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UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN



CLEAR THE WAY

By Major General Clair F. Gill
Commandant, U.S. Army Engineer School

One Corps, One Regiment, One Fight

What an exciting time to be a soldier and an engineer! It has been an honor and a great privilege to have served as *your* commandant for the past two years. I titled this, my final note to you, with a thought that has had special meaning for me throughout my 30 plus years in uniform. *One Corps, One Regiment, One Fight* is a unifying theme which acknowledges that we are all part of the same team—whether military, civilian, or contractor; or TO&E/TDA Army, U.S. Army Corps of Engineers, or Department of Public Works. Ours is a noble profession based on the physical and technical realities of nature. It provides service and support to the Army, its combat maneuver elements, and the soldiers and civilians of this great nation.

I built on the term “relevancy” in two of my State of the Branch speeches during annual ENFORCE conferences here at Fort Leonard Wood. My intent was to awaken the broad engineer community to our *raison d’être* and to warn that we will be diminished by infighting or an unwillingness to change and adapt to a rapidly evolving world. We live in an environment that is largely governed by immutable laws of economics and physics (gravity, force, weather, etc.), but we can gain efficiencies through better use of the tools of science and technology, improved systems and automation, and improved business practices. We will never fall to irrelevance because of the critical nature of what we do: Engineers provide life support; mobility, countermobility, survivability, and topographic support; protect the environment; and construct structures and facilities. However, if we fail to react to our customers’ needs, do not demonstrate our ability to help others get their jobs done, or point the finger of blame at others, we will continue to suffer at the resource troughs. Counter to the basic principles of humility, we must extol the virtues of our soldiers and workforce and champion the great work that they do. We must

remain agile and flexible—and ready to do the dirty work.

Our hallowed Engineer School is evolving to meet the needs of the 21st century. On the 7th of June we broke ground for the construction of more than \$200 million worth of new educational and training facilities. We accomplished this with the assistance of the Kansas City District of the Corps of Engineers, a great civilian contractor, and much support from TRADOC and the Department of the Army. Now we are embarked on an exciting venture with our brethren from the Military Police and Chemical Corps branches to create a new schoolhouse concept we call the Maneuver Support Center or MANSCEN.

The top-quality facilities we will construct are just the visible part of this venture. Far more important is the spirit of cooperation we are engendering with our fellow leaders from Fort McClellan. Together we will consolidate and integrate what is possible, common, and makes sense, while protecting our branch identities. I can report that we will save the Army a *lot* of dollars and people. With your help we will make this venture work really well.

I’ve left some work in progress. For example, we are fighting to save the principles embodied in our ERI organizations, creating joint doctrine (which is moving quite well), and developing the Grizzly, Wolverine, and a family of mine-detection systems. A never-ending battle is the need to garner crucial resources needed to teach and train future generations of leaders and soldiers. We are beginning to think of ourselves as “masters of terrain,” but much remains to be done to make this reality. My replacement, MG Bob Flowers, will have his hands full as soon as he takes the reins at the end of July, but I know he has a competent staff to support him. I will tell General Flowers that he can count on the help and support of our great Engineer Regiment. Essayons and farewell.

Engineer

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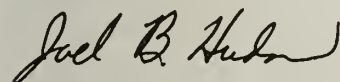
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Front Cover: The teleoperated robotic Panther II, with its M1 chassis, is the Army and Marine Corps' first functional prototype mine roller with vehicle-width rollers. It is equipped with a navigation system that allows an operator to preprogram a route or mission. Photo by Jim Ray, Fort Leonard Wood TSC.

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THE MULTIROLE ENGINEER BATTALION

By Lieutenant Colonel James R. Rowan

As U.S. forces prepared to move into Bosnia in late 1995, crossing the Sava River loomed as a major obstacle. In addition to the challenges of the river's width, depth, and bank conditions, and the unknown enemy and mine-threat situation, there was the overarching challenge of command and control of the crossing area. The 1st Armored Division needed general support engineers to emplace a float bridge and execute the engineer tasks required to conduct a deliberate river crossing of the division and a large portion of V Corps assets. This mission was assigned to the 16th Engineer Battalion (Corps)(Mechanized) and Task Force Volturno, named for the Volturno river crossing conducted by the 1st Armored Division and the 16th Engineer Battalion in Italy during World War II. This article describes the formation of Task Force Volturno, the missions executed during Operation Joint Endeavor, and the benefits of a multirole engineer battalion for future operations.

Task Force Volturno

When initially formed, Task Force Volturno included the 16th Engineer Battalion, the 502d Engineer Company (Assault Float Bridge), the 586th Engineer Company (Assault Float Bridge), the 38th Engineer Company (Medium Girder Bridge [MGB]), and the 535th Engineer Company (Combat Support Equipment

[CSE]). With this organization, the task force had mechanized combat engineers capable of conducting any combat engineer mission. In addition, there were fixed and float bridge companies to cross the Sava River and the CSE company to build and upgrade roads, access routes, approaches, and ramps into the river.

The task organization of separate companies under a corps mechanized engineer battalion follows current Army doctrine. FM 5-100, *Engineer Operations*, states that one of the capabilities of such a battalion is to provide command and control for assigned and attached units. Task Force Volturno deployed out of Germany ahead of the 1st Armored Division's organic engineer assets and arrived in Croatia and Bosnia before the direct support engineer units aligned with the division's two brigade combat teams. Based on a habitual training relationship developed in Germany, two companies of the 16th Engineer Battalion were prepared to provide engineer support to the 1-1 and 3-5 Cavalry Squadrons and the 4-12 Infantry Battalion. Using corps engineer assets allowed these key maneuver units to have dedicated engineer support as they moved into Bosnia ahead of the other 1st Armored Division maneuver and engineer elements. Meanwhile, the Task Force Volturno headquarters, one line company, and the separate companies completed the missions associated with crossing the Sava River.



A bulldozer from the 535th CSE prepares ramps at the Sava River to support the division's redeployment to Germany.

Missions

The 1st Armored Division Engineer Brigade commander realized the advantages the multirole engineer battalion provided to division operations and elected to keep Task Force Volturno intact throughout Operation Joint Endeavor. Early in 1996, the float bridge companies returned to their home stations, and the 55th Engineer Company (MGB) joined the task force. With its mix of combat engineer companies, bridge companies, and a construction company, Task Force Volturno could execute almost any engineer mission required in the 1st Armored Division sector. As U.S. forces moved farther south into Bosnia, elements of Task Force Volturno continued to move ahead. They cleared and proofed routes, upgraded main supply routes, conducted hundreds of kilometers of route reconnaissance, reconned and classified more than 100 bridges, emplaced armored vehicle-launched bridges (AVLBs) to upgrade key routes, built MGBs, and hauled in gravel to construct much-needed parking and maintenance areas.

Force Structure. Throughout the first 11 months of Operation Joint Endeavor, four battalion-sized U.S. engineer units operated in the Task Force Eagle sector under the 1st Armored Division Engineer Brigade commander. Two divisional engineer battalions (the 23rd and the 40th) were in direct support of the two brigade combat teams. The 16th Engineer Battalion (Corps)(Mechanized) and the 94th Engineer Battalion (Combat)(Heavy) operated in general support of the division. Several smaller engineer units operating in the U.S. sector came from multinational brigades—Russian, Danish, Finnish, Swedish, Turkish, Hungarian, and Romanian.

Task Organization. Within this robust engineer force structure, Task Force Volturno brought several unique capabilities to the fight, the most important being the ability to internally task organize for any mission. The combat engineer battalion provided a mechanized force capable of conducting clearing or proofing missions. Organic .50-caliber machine guns mounted on armored vehicles provided security. Bridging was possible using either AVLBs or the MGB company. Several MGBs were emplaced and later replaced with Bailey bridges. Since the bridge companies were attached to Task Force Volturno, the security and countermining capability typically required for bridging in Bosnia were provided without additional units. Task Force Volturno also ran a theater bridge park with up to seven sets of Bailey bridges on hand. Horizontal construction and a tremendous haul capability also were available within the task force.

Since it had such diverse capabilities, Task Force Volturno was located at Camp Bedrock in the center of the Task Force Eagle sector. The 1,200-man base camp was the only base camp in Bosnia where an engineer commander served as the senior tactical commander. The central location allowed task force units to operate anywhere within the U.S. sector. The mix of wheeled and tracked vehicles allowed soldiers to operate throughout the division's vast geographic area.

Task Force Volturno units augmented the 23rd and 40th Engineer Battalions, which supported the 1st and 2d Brigades of the 1st Armored Division. Typical support included minefield clearing; bunker destruction; and hardstand, combat trail, and ammunition holding area construction. Task force companies also provided engineer support to units in the division that lacked a task force engineer battalion in direct support of their base camps and operations. These units

included the corps support group, the divisional aviation brigade, the artillery brigade, the division main, the division rear, and several remote signal sites within Tuzla Valley.

Force Protection. For Task Force Volturmo units, the primary engineer mission was assisting with force protection at base camps. The task force constructed several hundred bunkers and fighting positions throughout Bosnia. They also provided technical expertise and supervised the sandbagging of these structures. The task force emplaced more than 100 kilometers of triple-standard concertina wire and built numerous checkpoints and guard points. The division used concertainers (cloth-lined, wire mesh bastions filled with rocks, sand, shale, and earth) to provide protection against direct-fire weapons. Because of the high cost of delivering vast amounts of fill to base camps, task force units began a shale quarry. They hauled more than 50,000 cubic meters of fill for protective structures. This was critical because divisional battalions do not have dump trucks. By combining the assets of corps mechanized companies, the bridge companies, and the CSE company, Task Force Volturmo had the equivalent of more than 100 5-ton dump trucks to conduct their enormous haul mission.

General Support. The general support role of Task Force Volturmo allowed the division engineer some latitude in directing engineer efforts. Maneuver brigade commanders kept their direct support engineers fully employed. The general support engineers gave the division a capability to shape the future battlefield. They worked on redeployment routes, bridge and raft ramps, bridge anchor systems, and redeployment base camps while direct support engineers concentrated on such zone-of-separation missions as clearing minefields and destroying bunkers and trench lines.

Each of the multinational brigades brought an engineer capability, but they sometimes lacked enough engineer forces to complete missions within their sector. The multinational engineers were attached to their country's maneuver forces and did not receive orders through U.S. engineer channels. General support engineers allowed the division engineer to influence engineer efforts in the multinational brigade sectors without having to change the division's task organization or become overly directive with another nation's forces.

Countermining. As the only corps mechanized engineer battalion in Europe, the 16th Engineer Battalion was charged with becoming the countermining proponent. Long before deployment, battalion officers and senior NCOs and engineers from other units in Europe trained at Fort Leonard Wood to develop a countermining assessment and a training plan for units deploying to Bosnia. The 16th Engineer Battalion conducted mine-orientation training for the division units deploying first. When the battalion received orders to deploy, training was moved to the Combat

Maneuver Training Center (CMTC) in Germany. The CMTC adopted the battalion's program of instruction as the standard for all U.S. soldiers and support personnel deploying into theater.

Benefits

The 16th Engineer Battalion was able to successfully organize and accomplish a wide range of missions. Some benefits of a multirole engineer battalion include:

- As general support engineers, they were not as constrained by habitual relationships as the direct support engineers. The unit could internally task organize and mass efforts as needed. The direct support engineers of a division typically are allocated an engineer company in support of a maneuver task force, and it can cause great concern within the brigade if one task force loses its normal share of engineer battalion assets.
- The corps mechanized modified table of organization and equipment (MTOE) supports a large, diverse organization better than the divisional MTOE.
- Corps mechanized units have a slightly greater command and control capability because they are authorized a communications officer, an intelligence officer, and a maintenance officer. These positions are not supported under the divisional MTOE.
- More maintenance personnel are allocated to a corps mechanized unit than to a divisional engineer unit. This extra maintenance capability allows units to operate over greater distances and to be less reliant on a maneuver task force for maintenance and recovery support.

Task Force Volturmo also provided several less obvious benefits:

Command and Control. A key advantage was the task force's ability to provide command and control to the separate engineer companies. Doctrinally, the engineer brigade headquarters performs this mission. However, the austere headquarters of a division engineer brigade supporting 15 brigade-equivalent units could not provide the same degree of support to companies as Task Force Volturmo.

Flexible Structure. The capabilities within the multirole engineer battalion provided the engineer brigade and the division commander with a flexible engineer structure. While engineer units were never kept in reserve, the multirole battalion was able to reallocate forces and respond quickly to several emergencies within U.S. and multinational brigade sectors.

Professional Development. There were many developmental opportunities for officers assigned to the task

force. Officers from attached companies typically worked in their specialized area and seldom interacted with other companies or a battalion staff as task force officers did during Operation Joint Endeavor. In turn, the attachment of up to four additional companies with very different equipment and personnel provided a tremendous opportunity for battalion staff officers to manage a wide spectrum of requirements. FM 5-100 states that an engineer battalion can provide command and control for up to five companies. Task Force Volturno's ability to continuously command and control six to eight units was due to the mission, enemy, terrain, troops, and time available (METT-T) in Bosnia. Once the Task Force Eagle sector was established, the headquarters was relatively stationary and secure and could devote additional staff effort to the companies. Also, the deliberate pace of this operation allowed a greater span of control than the typical fast-paced, high-intensity operation allows. All task force members benefited by working together on the wide variety of missions—mine clearing and proofing, bridge and route reconnaissance, force protection, road construction and repair, airfield construction, bridge construction, overhead anchorage system design and construction, security, and base-camp construction and decommissioning.

Limitations

Task Force Volturno overcame several limitations, most of which could have been avoided with proper planning.

Funding. Funds were suspended or diverted from many corps units to pay for the 1st Armored Division's mission in Bosnia. The 16th Engineer Battalion's deployment preparations were halted or delayed several times due to insufficient funds. Eventually, the 1st Armored Division Engineer Brigade provided funds for critical deployment supplies.

Reports and SOPs. Even though most Task Force Volturno units were from the 130th Engineer Brigade and were assigned to the same corps as the 1st Armored Division, they used different reports and tactical standing operating procedures (SOPs). The problems resulting from these differences decreased as Bosnia-specific SOPs were developed and implemented.

Equipment. The fielding of new equipment, specifically the single-channel, ground-to-air radio system (SINCGARS), had not been completed for all corps units when the deployment order was received. New radios were installed, but this placed great logistics and training burdens on units that were already busy with countermine operations

and deployment preparations. The 55th Engineer Company from Fort Riley, Kansas, never received the SINCGARS and had to rely on older, less capable, and not fully compatible 12-series radio systems.

Logistics Support. Once in sector, continual changes in the maintenance and supply units providing support was a major challenge. The 16th Engineer Battalion was supported by six different maintenance units during its deployment. With each change, the logistics trail became longer. During one period, repair parts were unavailable while the supply system tried to catch up with the tactical situation.

Personnel. As the deployment continued, personnel shortages increased. Early in the operation, Task Force Volturno units were resourced at 100 percent of their authorized personnel strength. Throughout the year-long deployment, losses exceeded gains, and by the end of the year units were down to about 80 percent of their authorized personnel. Divisional engineer unit strengths declined at a lesser rate. Although Task Force Volturno units were attached to the 1st Armored Division, personnel managers in the division could not affect personnel strengths in attached corps units since they would eventually redeploy to their home stations.

The Future

The multirole engineer battalion works—it was validated in the Balkan theater of operations. While this operation had a specific mission with a unique set of METT-T, it is possible to extrapolate and visualize that the concept has great potential for any operation where corps engineers will be called into a division sector. The multirole capability currently is being fielded for bridge units. Now is the time to establish the corps mechanized engineer battalions as multirole task forces. The minor problems encountered in Bosnia could have been resolved in a training environment, making the task force more effective and quicker to establish when needed. The force structure is in place. This proposal does not require additional forces or funds. Let's task organize now and get the most out of the engineer resources we have available.



Lieutenant Colonel Rowan commands the 54th Engineer Battalion in Bamberg, Germany, and commanded the 16th Engineer Battalion and Task Force Volturno in Bosnia-Herzegovina. He previously served with the 7th, the 82d, and the 299th Engineer Battalions; the 4th and the 5th Infantry Divisions; and was an assistant professor of mathematics at West Point. LTC Rowan is a graduate of the U.S. Military Academy and holds a master's degree in Operations Research from Georgia Tech and a master's of Military Arts and Science from the Command and General Staff College.

Multinational Mine-Strike Recovery Operation

By Brigadier General Stanley F. Cherrie



During my 32-year (plus) military career, I have had the great fortune to garner a significant amount of service in multinational assignments. It began in 1979 with assignment to the British Army Staff College. In 1992, I became deputy chief of staff, G2/G3, of the Ace Rapid Reaction Corps (ARRC), where we planned and were ready for deployment to Bosnia in support of a NATO peace-enforcement mission. In 1994, I moved to the 1st Armored Division as the assistant division commander-maneuver. Little did I know that I soon would be thrust in the middle of NATO's Operation Joint Endeavor peace-enforcement mission and be part of the largest multinational peacekeeping operation in history. During the fourth month of this American-led, Multinational Division North operation, I assumed control of the mine-strike recovery operation described in this article.

Diary commentaries are presented to demonstrate the complex nature of multinational operations and the advantages provided by the breadth of engineering skills available in multinational units. The commentary shows how difficult it is to operate in a heavily mined area.

The Mine Strike

17 April 1996. A multinational patrol from the Nordic/Polish (NORDPOL) Brigade became disoriented while patrolling the zone of separation. The group, consisting of two Danes and nine Lithuanians, entered a minefield and struck an antitank mine with their lead vehicle, a Mercedes GD240, which is a small, jeep-type vehicle. The driver, a Danish private, was thrown from the vehicle and sustained fatal injuries. The commander, a Lithuanian lieutenant, was trapped under the overturned vehicle and subsequently died. Two back-seat passengers were critically injured and thrown free of the vehicle. Patrol members in the other two vehicles (another GD240 and an ambulance) were not injured. U.S. medical evacuation (MEDEVAC) helicopters carrying Norwegian Medical Company personnel were flown to the scene and lifted the survivors to safety (see diagram, page 7).

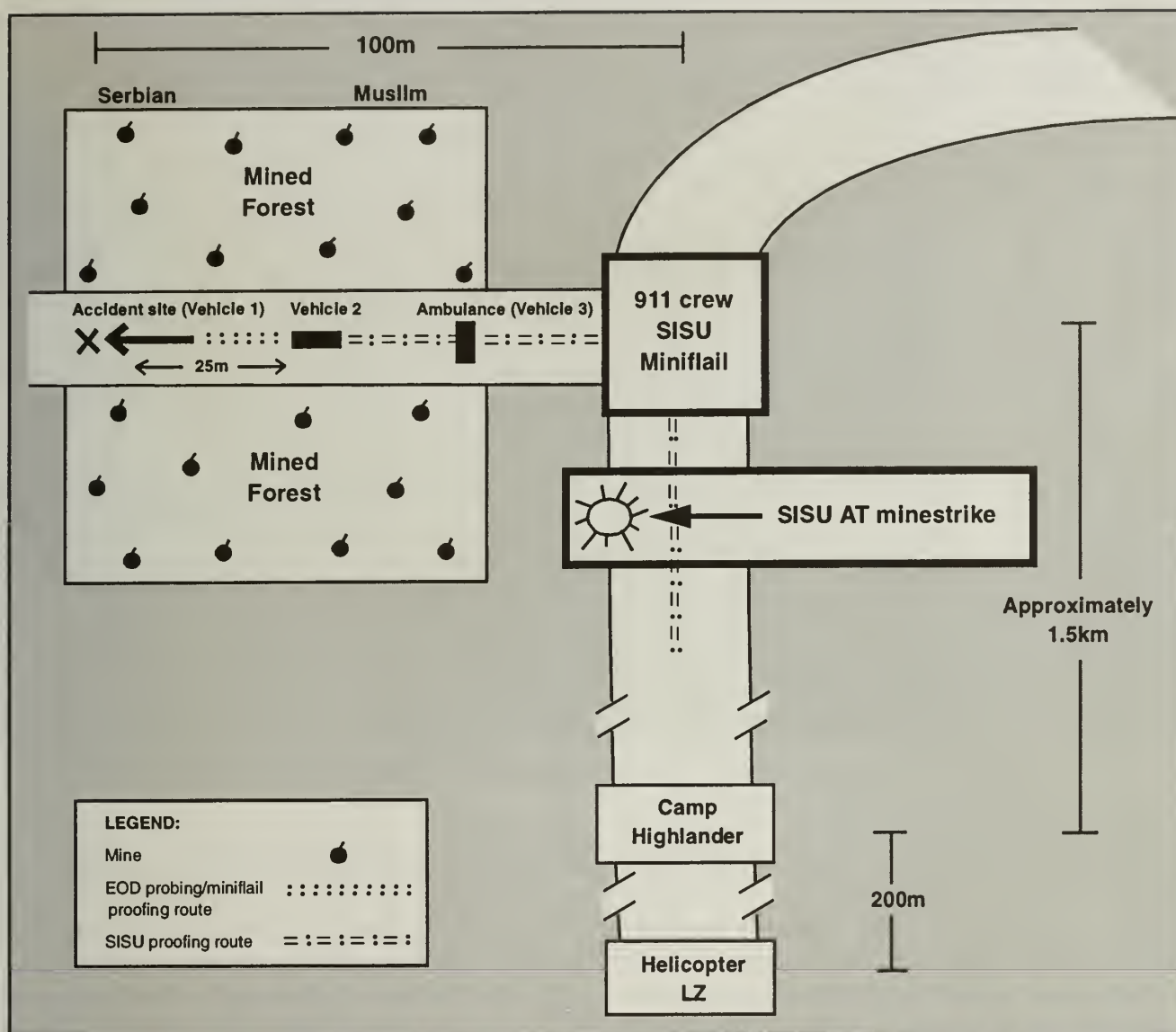


Diagram of Events

The Recovery

18 April. The Danish Battalion (DANBN) set up a camp about 1.5 kilometers from the accident site and assembled recovery personnel, equipment, and a command and control element. The camp was called Camp Highlander because it was atop a lofty saddle in the northwest (NORDPOL) sector of Task Force Eagle (see diagram). The DANBN conducted a photo reconnaissance of the mine-strike area, and their photographic data proved to be invaluable in the recovery effort.

The recovery team discovered that the road to the accident site and the associated wood line, although not a designated or marked minefield, were heavily mined. Initial clearing and proofing operations to approach the accident site detonated several antitank and antipersonnel mines, making progress very slow and deliberate. Near the end of the first day, the body of the Danish soldier was recovered. At the end of the day, the Lithuanian soldier's body and three vehicles remained in the minefield.

19 April. The operation started late because the Finnish SISU mine flail, a large, 6-wheeled, armored vehicle, slid off the narrow mountain approach trail, blocking the entrance to the command-and-control site. Then, when it was recovered and began flailing, it hit a large antitank mine and was disabled (see diagram).

An assessment of the events that had taken place thus far produced the following significant facts and deductions:

- This was a NORDPOL mission with Task Force Eagle in support.
- Political decisions regarding the local memorial ceremonies and subsequent national funeral arrangements made time an extremely important factor.
- The major approach route and the area around the vehicles were heavily mined. Examinations of mine-sheet data from both NORDPOL and the U.S. indicated mixed (Serbian/Muslim) minefields, which made the extrication mission even more hazardous.



SPC Orasco, 16th Engineer Battalion, and the U.S. miniflail depart Camp Highlander enroute to the recovery site.

- Task Force Eagle units possessed the requisite equipment and expertise to effect the extrication without further loss of life.

The Task Force Eagle commander directed me to move to the site and assure the NORDPOL command structure that the task force would provide any assistance possible. We conducted a miniature war game of options as to how to best use all of Task Force Eagle's expertise to recover the body as quickly as possible without further injury or loss of life. We determined that equipment such as MEDEVAC helicopters with winches, SISU mine flails, the U.S. robotic miniflail, and a "911" rescue team were needed to accomplish the mission.

20 April. For a host of cogent reasons, the U.S. 16th Engineer Battalion had independently scheduled an aerial reconnaissance in preparation for the extrication. In an operation requiring deliberate action and strict delineation of responsibilities, this type of independent action was a problem that could not be allowed, so I cancelled it. We needed one chain of command or the operation would break into factions working against each other, thus increasing the potential for further tragedy. The energies of the entire task force had to be channeled into one recovery effort.

UH60s flew us to the accident site. Before landing, we made several aerial passes over the site to become oriented and bring the digital images we had studied into perspective. From this overflight, we got a true feeling for the environment in which our forces would operate.

We landed on a narrow gravel mountaintop road (see diagram, page 7) and walked 200 meters to Camp Highlander. The DANBN commander and his operations officer then briefed us around a small-scale model of the area made from baked mud, twigs, string, etc. It was primitive but effective.

We first considered an aerial option wherein we would lower explosive ordnance disposal (EOD) personnel onto the second vehicle, allowing them to use this "safe haven" as a starting point for hand probing a 1-meter x 35- to 40-meter lane to the destroyed vehicle. Once this time-consuming procedure was accomplished, the 911 crew would be lowered to the second jeep, where they would use the cleared lane to the vehicle and free the lieutenant's remains. We discarded this option, however, because of the level of training needed to lower personnel onto a 2-meter-by-2-meter platform surrounded by mines and the inordinate amount of time required to deliberately probe nearly 40 meters.

An alternative ground option was developed using the large Finnish SISU flail to clear a path to the ambulance, remove it, then flail to the second vehicle. We would then use the U.S. miniflail to beat a path from the second vehicle to the accident site. We considered the risk of ruining the miniflail if it hit an antitank mine, but time was critical and the risk was considered acceptable. Our multinational allies had mixed reactions to this plan.

Another alternative involved using the Serbian engineers who had supposedly sited the minefield. They wanted to be



Probed work area shows the left front side of the overturned vehicle.

flown to the other side (the Serbian side) of the minefield and probe back from there. Data from our Task Force Eagle mine center indicated that the area contained mixed Serbian and Muslim mines. Therefore, regardless of the Serbian engineers' courage, this option was considered to be far beyond the prudent risk assessment limits allowed for U.S. forces.

Everyone reluctantly conceded that the ground option was the best all-around plan. However, the DANBN commander informed us that the SISU mine flail, the "backbone" of the ground option, could not be at the site for several hours. This unexpected delay caused us to reevaluate our plans because, in my opinion, we could not "burn" 6 or 7 hours of daylight waiting for the flail to arrive.

After another hurried meeting around the terrain model, we decided to use a combination of the ground and air options. This was possible because a significant capability had just emerged from within the task force. The Russian engineers had offered a team consisting of two engineers and a sniffer dog with a handler. The Russians had used this combination with great success in Afghanistan, and it seemed a great boost to our ability to safely approach the area.

About 1430, the NORDPOL Brigade commander arrived on site to assess progress and was briefed on our plan. We also conducted operational briefings to the MEDEVAC crews and EOD personnel who would do the flying and rappelling. Then they returned to their helicopters for some on-site crew training and rehearsal of winch and harness-lowering techniques. Although the rehearsal process consumed valuable daylight hours, this was a "no shortcuts" operation from start to finish. Rehearsals were a must!

At 1630, both MEDEVAC helicopters flew to the accident site, where the insertion of EOD personnel began. The intent was to conduct both the ground and air operations simultaneously until the flailing and command and control

helicopter noise became too distracting to the soldiers doing the deliberate probing.

Shortly after 1800, while the probing operation was still in progress, we gathered again to discuss plans for the next day. Timing, command and control, and equipment positioning were key issues that had to be hammered out.

Meanwhile, with darkness approaching, air removal of the EOD personnel was being executed according to plan. Once that was done, we made a short telephonic situation report to the Task Force Eagle commander. Before retiring for the night, we made sure that everyone had the next day's schedule and their mission order and that the necessary equipment was ready and available.

21 April. Back at Camp Highlander, we gathered around the invaluable hand-made terrain model, where the Danish engineer company commander gave a briefing on the morning's projected activities. The large Finnish flail had cleared its way to the ambulance without incident and was to retrace its route to the base camp to ensure a mine-safe status on the approach road. We had decided to use the larger flail for that task because the miniflail could not withstand an antitank mine strike. We would save the miniflail for the much-needed close-in work. Around 0730, while clearing behind the ambulance, the large flail hit the first of several antipersonnel mines.

The MEDEVAC helicopters arrived on time and inserted the EOD personnel as planned. Shortly thereafter, the combat camera crew arrived and was briefed on the situation. Their mission was to capture the multinational nature of the operation and focus on the equipment and techniques used. Their photographs were important for later evaluation and analysis.

Now that the mission was in progress, it was time to think about what was next. The future challenge was the close-in mine clearance near the vehicle itself. The 911 crew needed



Russian mine-sniffer dog and handler.

space to work safely when removing the victim from under the vehicle. Although the crew was good, their certification training did not include performing in such limited space or under these hazardous conditions.

While gathered around the terrain model, we used aerial photos of the site to formulate a plan that integrated the probing efforts with that of the miniflail. The miniflail operator understood what was required and was qualified, trained, and ready to tackle the task.

The morning quiet was shattered by a thunderous boom when Swedish EOD personnel detonated another mine along the edge of the access road. Shortly thereafter, the Russian sniffer team began to proof the road leading to the accident site.

About 1000, the miniflail operator began the 1 1/2-kilometer walk to the accident site in his leaden shoes and antifracture gear. Everything we had planned was in motion, and there seemed to be more than enough daylight to accomplish the task.

Shortly after 1100, problems began to occur. My experiences in the multinational arena had taught me to "expect the unexpected." From this point on in the

operation, that axiom held true. For example, the Russian team, whose mission was to clear only to the back of the ambulance, took it upon themselves to go half-way to the second vehicle, picking up antipersonnel mines by hand, disarming them, and throwing them into the woods. This was extremely hazardous and not in the plan. It had to be stopped—which I did as quickly as possible.

Another deviation from the plan soon occurred. Although we had decided to clear a semicircle around the objective vehicle, the probers had begun to clear a full circle. This option was the safest to be sure, but it was not possible due to the time constraints posed by political pressure to remove the body and meet mandated funeral dates. After some discussion with the DANBN commander, he reluctantly stopped the EOD team from pursuing the circle-clearing option.

By 1130, the miniflail operator was in position. He was extremely warm in his protective gear but had the foresight to strap a dozen bottles of water to his machine before leaving base camp. The Danes joked about having to take a break to turn the miniflail operator upside down to drain the water from his suit! Although we were working under extreme pressure, spirits were high among the multinational team.

Around 1300, the EOD personnel completed their mission. In addition to the two probers, we had inserted a third EOD member after giving him a short lesson on how to operate the digital camera and hand-held video camera. We would use his close-up photos in a full dress rehearsal with the 911 personnel. These pictures allowed the 911 crew to determine which equipment from their huge arsenal of tools was needed at the site.

After the EOD team had been removed, the SISU flail began its flailing operations and set off 10 to 12 antipersonnel mines. These explosions confirmed our assessment that the area was thickly infested with mines.

By 1600, conditions were set to begin the extrication phase of the operation. An access route to the second jeep had been demined and the ambulance removed. The miniflail had cleared a lane wider than the probed lane around the second jeep to the accident site. The SISU command vehicle and the 911 crew and their equipment were standing 100 meters to the east of the site along with the SISU flail. A second miniflail with an operator and Swedish EOD personnel were waiting in reserve.

At this point, progress seemed to come to a halt. We still had more than three hours of daylight and could not afford to squander any of it. I discovered that the mission holdup was because several Swedish EOD personnel were painstakingly hand sweeping an area that had been flailed for two hours. Their intent was to gain assurance that the area was cleared of mines. While that was the 100-percent risk-free measure, it would obviously take until dark to complete. Additionally, their activity was not part of the plan and had to be stopped so we could continue the operation. I issued orders to curtail this activity and soon had it under control.

Sequence of Events

17 April

- An 11-man patrol from the NORDPOL Brigade hits an antitank mine, killing two soldiers and seriously injuring two others. One of the dead soldiers is pinned under the disabled vehicle.
- MEDEVAC helicopters rescue the survivors.

18 April

- Camp Highlander is set up to house the team tasked to recover the two bodies.
- Initial mine-clearing operations begin.
- The body of one soldier is recovered.

19 April

- A Finnish SISU mine flail begins to flail toward the accident site.
- SISU flail is totally disabled when it hits a large AT mine.

20 April

- Second SISU flail is ordered to the accident site.
- EOD personnel rappel into the accident area to probe.

21 April

- Flailing operations get to the ambulance and vehicle 2.
- Ambulance is removed.
- Russian mine-sniffer team proofs the road to the disabled vehicle.
- Miniflail operations are conducted to the accident vehicle.
- The body of the trapped soldier is recovered.

The miniflail began to flail the area along the north side of the destroyed vehicle. On its third pass, the miniflail became stuck. After several attempts to extricate it, we opted to leave it there and proceed with the rescue operation.

By 1830, the rescue team began to lift the jeep with hydraulic jacks. We lowered the litter basket to the clearing behind the second vehicle, and at 1835 the body was lifted out. As the command and control element, we presented arms and held our salute until our comrade-in-arms was taken aboard the helicopter and flew out of sight.

Lessons Learned

My 5-year association with multinational forces has given me a solid appreciation for the characteristics of foreign armies, which sometimes are markedly different from those of the U.S. Army. The recovery operation described herein embodies many of these characteristics. Lessons learned from this operation should

be applied to training and preparations for future operations—both peacekeeping and war.

- Multinational operations take more time! Differences in language; tactics, techniques, and procedures (TTP); and doctrine cause the pace to be *much* slower than usual. Operations must be planned in detail, discussed thoroughly, and rehearsed more often than in a national unit.
- Other nations sometimes have equipment and capabilities that we do not possess. Multinational commanders must know the *total* capabilities of their forces and optimize the mixture for efficient mission accomplishment. The Swedish EOD capability, the Finnish flail, our miniflail, and the Russian mine-sniffer team are perfect examples of this mixture.
- Operational commanders must issue orders in a tactful and diplomatic manner. The orders process in multinational operations often is more collegial and less structured than the U.S. process. Firm control is still a must. Time in the unit and seasoning are the enablers for the rookie U.S. commander here.
- Multinational operations tend to generate actions that are independent of the basic plan. I believe this is more a function of organizational differences and a lack of understanding than mere impulsiveness by subordinates. Such actions must be recognized and kept in check.

Summary

Experience has shown that soldiers of all nations have a deep core of professionalism that is displayed by all ranks when called upon to tackle tough missions such as this mine-strike recovery operation. Although predominantly a NORDPOL operation, the entire task force's resources were brought to bear in a truly multinational effort to extricate the personnel and equipment involved in this disaster. The EOD probers, the flailers, the dog handler, the miniflail operator, the helicopter winch operator, and the pilots all shared a common bond of professionalism. When their skills were combined, they spelled mission success.



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All photographs by the 55th Signal Company (Combat Camera)

More Than Technology

By Major Judson Cook

Much discussion goes on in the profession of arms about whether the technological developments and capabilities available to U.S. armed forces constitute a revolution in military affairs. The ability to dominate information warfare, the use of unmanned aerial vehicles to gather intelligence, and a tactical and strategic internet supported by satellite communications certainly change how we plan to fight wars. However, history has shown that technological developments alone are not adequate to achieve decisive victory.

In very recent history—28 January to 6 February 1997—the U.S. Army simulated a future conflict involving the U.S. military. Personnel in the "Army After Next" program, a research group at Training and Doctrine Command, organized the war game to examine warfighting issues possible within the next 25 years.

In this war game, friendly (Blue) forces were surprised when, at the outset of the battle, the opponents (Red) destroyed their satellites. Blue forces relied on the satellites to provide the intelligence platforms and digital communications links needed to facilitate command and control and track logistics flow. The strikes against satellites confounded the Blue leadership because their war plans were based on an assumption of information dominance. While the attack destroyed most of both the Blue and the Red satellites, Red was willing to sacrifice their satellites because Blue was more dependent upon them and, therefore, had most to lose from their destruction. One observer reported that the strike against satellites took the war back to the 1950s in terms of technology.¹

Rationale

Nations focus on developing new technologies and improving war machines that increase their ability to directly destroy the opposing force. Superior killing systems are important, but they are not the only basis for winning wars. Regardless of technological advances in warfare, sooner or later combat becomes close-up—a man-against-man struggle for survival. This has been true in warfare from the first conflict through the last and is not likely to change. The following example typifies this maxim by showing how technology cannot replace the human dimension of war.

Pacific Theater, World War II

In the Pacific theater in World War II, the United States understood the importance of technology but recognized that machines were merely a means for achieving a strategic end. In the 1930s, Japan and the United States (in the U.S. "Orange Plan") envisioned similar war plans. The two nations anticipated an initial Japanese conquest of the islands in the western Pacific, a U.S. effort to fight its way across the ocean toward Japan, and that the end of the war would result from a fleet-against-fleet battle.² The United States therefore developed machinery and weapons to assist in this great naval battle.

As the war in the Pacific developed, the United States equipped itself with modern aircraft carriers, bombers, submarines, and destroyers to pursue a strategy designed to cut off the Japanese from critical resources, devastate the Japanese economy's ability to produce war machines, and demoralize the

Japanese population, thereby causing their government to collapse. In 1941, Japan had more naval power available than the United States—they had 63 submarines and 10 carriers, while the U.S. had 56 submarines and two carriers. By 1942, Japan increased its carrier fleet to 11 (with 550 aircraft)³, but by 1943 the U.S. increased its naval presence to 600 warships with 1,941 carrier-based aircraft.⁴ Although both nations developed technologically advanced fleets, a great naval battle between the opposing fleets did not decide the outcome of the war.

The Japanese used their modern weapons to deliver the first blow. In December 1941, Japanese naval vessels and aircraft struck a surprise attack against the U.S. fleet at Pearl Harbor. Following that attack, the Japanese enjoyed a 6-month winning spree as they expanded their base of operations from Japan into the Pacific Ocean. Because the Pacific is so vast, both countries found it necessary to gain operating and logistical support bases for their great fleets on various islands.

Land warfare in the Pacific was born of the need to maintain these forward operating and logistics bases. From December 1941 to April 1942, the Japanese gained control of Malaya, the Philippines, Singapore, and Bataan. The Japanese influence spread over the Pacific as powerful U.S. military leaders were forced to withdraw. The United States found itself on the losing side of a war for control of the Pacific. Millet and Maslowski offer a great summary of the U.S. perspective on the Pacific. They write:

After the Allied rout in Burma in May 1942, General Joseph W. Stilwell

spoke of the disaster in his theater, but his words applied to the entire American experience in the first six months of World War II:

*"I claim we got a hell of a beating...and it is humiliating as hell."*⁵

The United States resorted to a ground campaign partly to gain operating and logistics bases and partly to gain respect. Regardless of the reasons for the island-hopping campaigns across the Pacific, the United States committed itself to waging battle against an enemy prepared to fight to the death. Because of the distance of these island outposts from Japan (and later due to successful U.S. submarine attacks against Japan's merchant marine), the Japanese land forces were cut off and lacked resources. With their backs against the wall, the Japanese fought to retain their territory.

U.S. military leaders could not and did not rely solely on technology to achieve their strategic goals against Japan. The battle for Iwo Jima, which lasted for a month in 1945, was typical of the fierce fighting that occurred in the Pacific. The capture of this island, valued as a base for crippled B-29 bombers returning from runs against the Japanese, cost the U.S. forces 26,000 casualties, of which 6,000 were deaths. U.S. Marines fought against an invisible enemy entrenched in caves and bunkers equipped with machine guns. U.S. forces used flame throwers, grenades, and explosives to route them from their hiding places. Thus, the United States employed troops on the ground who were engaged in close, direct combat. Their intent was to gain territory that would enable the United States to pursue its strategic bombing campaign against Japan. U.S. ground forces fought the Japanese to gain safe airfields for the 25,000 air-crewmen (flying 2,400 B-29s) who made emergency landings on Iwo Jima from March to August 1945.⁶

In the 2 1/2-month battle for Okinawa in 1945, the Americans had close air support and more artillery than the Japanese, who again were dug into a

"...Even as nations develop technology and improve weapons systems, they must understand that war requires the commitment of ground soldiers who are willing to die to defeat their enemy."

system of caves and bunkers. Even with their technological advantages, the Americans had to mount an infantry assault to overcome the Japanese. As at Iwo Jima, the fighting caused heavy casualties (100,000 Japanese soldiers and 40,000 U.S. soldiers killed).⁷ The Americans were beginning to learn a lesson we would have to relearn in the Korean Conflict and the Vietnam War:

*...you may fly over a land forever; you may bomb it, atomize it, pulverize it, and wipe it clean of life—but if you desire to defend it, protect it, keep it for civilization, you must do this on the ground, the way the Roman legions did, by putting your young men into the mud.*⁸

The point is that even as nations develop technology and improve weapons systems, they must understand that war requires the commitment of ground soldiers who are willing to die to defeat their enemy. Advanced weapons systems alone have never won a victory.

Another related point is that a technologically or materially inferior enemy can fight on terms that negate the superior force's advantage. By 1945, when the battles at Iwo Jima and Okinawa were fought, the U.S. subma-

rine campaign against the Japanese merchant fleet and strategic bombings on the Japanese mainland left Japanese ground forces wanting for supplies, materiel, and reinforcements. Yet, to be decisive, the United States resorted to close ground combat—the very form of warfare that the enemy was most capable of waging. The same argument held true for the U.S. action in Vietnam. Similarly, in the futuristic war game described above, the Red force evened the playing field by crippling the Blue force's informational advantage.

The Lesson

U.S. military forces should continue to develop technology and improve weapons systems. Engineer modernization efforts focus on systems that improve enemy and friendly situational awareness, development of digitized terrain systems, and development of intelligent mine systems. These systems enhance engineer support to the maneuver commander, make engineer contributions to combined arms operations relevant into the 21st century, and increase the lethality of the U.S. Army. But as we develop these systems, we must realize that they are merely a means to an end. We must maintain enough vision to recognize that overdependence on dominating the battlefield via technology has failed in the past. The human dimension in combat must remain paramount.

We should not develop a force based mainly on the assumption that we can achieve perfect intelligence and flawless situation awareness. As we learned in the 1997 Army After Next war game, our assumptions may prove invalid. Our adversaries may mimic our technology, develop a countermeasure that defeats it, or resort to a form of warfare that renders it useless. In the end, battles and wars are won because of the will and determination of young people willing to fight against an equally determined enemy. It would be an error to convince ourselves and our nation otherwise.

(Continued on page 15)

Engineers Working Smarter—Not Harder

By Major Anthony C. Funkhouser and Second Lieutenant Mabry Sumner

Every engineer who has ever driven pickets for hours on end has little affection for the cast iron, 40- to 50-pound driver. During countless repetitions, they pick it up over their head and drop it to drive pickets into ground that is often rocky and dense. The opposing force (OPFOR) engineers at the National Training Center (NTC) drive more than 3,500 pickets per rotation in some of the rockiest terrain at Fort Irwin, California. So the 11th Armored Cavalry Regiment set out to find a better way.

The Regimental Engineer Section's NCOIC contacted a commercial vendor for brochures on pneumatic post drivers of various sizes and capabilities. A local vendor came to the NTC to demonstrate a medium-duty post driver weighing 54.6 pounds and requiring a 42 cubic feet per minute (cfm) compressor set at 90 pounds per square inch (psi). It operated off the 58th Combat Engineer Company's (OPFOR) standard 250 cfm compressor and allowed us to connect two drivers simultaneously.

The demonstration was conducted in some of NTC's rockiest terrain known as the "Iron Triangle." By the end of the day, as a battle drill began to evolve, a squad with one post driver placed 300 meters of triple-standard concertina in 17 minutes.

Advantages

During the March 1997 Advanced Warfighting Experiment at the NTC, the



Soldiers from the 58th Combat Engineer Company operate the two-man post driver.

11th Armored Cavalry Regiment used the new post drivers, or "automatic picket pounders" as we call them, to build a motorized rifle battalion defense. During this defense, 1st Platoon/58th Combat Engineer Company (OPFOR) constructed 14 300-meter minefields with antifraticide fences and 14 300-meter triple-standard concertina fences in 12 hours. During the last 10 defenses before we had the new post driver, our average time for this work was between 16 and 17 hours. The automatic picket pounder operated similar to a pneumatic jackhammer and drove picket after picket.

A crew of four soldiers operated the automatic picket pounder. One soldier drove the 5-ton dump truck pulling the 250 cfm compressor, one carried the automatic picket pounder, one operated the throttle and untangled the hoses from bushes, and the fourth soldier held the pickets. The soldier operating the automatic picket pounder only had to guide the device on the picket. The weight of the device was sufficient to drive the pickets when it was operating. This crew drove pickets for a 300-meter triple-standard fence in less than 20 minutes. Installation time for a 300-meter minefield marking fence aver-

aged between 7 and 8 minutes. It took less than one second to drive a single picket.

The speed of the automatic picket pounder is only one of its benefits. It can also drive pickets in almost any type of terrain. When we had to build obstacles over broken terrain and on hard, compacted tank trails, the automatic picket pounder was extremely helpful. We did not put pickets across tank trails in the past, because we could not drive the pickets to the necessary depth with a manual driver. Even with the automatic picket pounder, soldiers had to increase the time the device operated and pull down on its handles to get the pickets into the ground.

On extremely rocky terrain, we only had to move the pickets around until we could wedge them between the rocks. Now that the picket crew was no longer exhausted from the endless pounding with the manual driver, they placed the pickets in deeper than normal, making it difficult to remove them. With the manual driver, we normally used 6-foot pickets and drove them an average of 6 to 8 inches deep. The average depth for the automatic picket pounder was 12 to 14 inches. The picket pounder ensured that there were no gaps in the obstacles and that the obstacles would not come out easily even in rough terrain.

Disadvantages

 In the minus side, the hoses that connect the automatic picket pounder to the compressor seemed to catch on every creosote bush in the desert as we moved across the obstacle frontage. The hose would then pull back on the 55-pound driver that the soldier carried. After constructing obstacles for several kilometers, this became very irritating. To overcome the problem, we constructed a boom to hold the device and route the hose up and over the boom to keep it off the ground.

Another problem with the picket driver was that it drove the pickets too

deep! When we policed the battlefield the day after a battle, it was hard to get the pickets out of the ground. We tried pulling them out using straps attached to a 5-ton dump truck, but the straps could not withstand the pressure without breaking. Then we tried using the winches on the 5-ton dump truck and the HMMWV and found that steel cables worked well in removing the pickets. In the future, we will not set the pickets so deep that we cannot remove them.

Conclusion

 In light of our experience, we recommend units consider locally procuring picket pounders if auxiliary power units are available. We also suggest that the Engineer School include hydraulic picket pounders as SEE attachments.

The automatic picket pounder has allowed us to increase the emplacement speed and effectiveness of obstacles. Its ability to drive pickets in all terrain and to any depth without exhausting the soldiers was a great benefit to the OPFOR. The post driver proved its usefulness during the Advanced Warfighting Experiment and will continue to be an integral part of OPFOR obstacle emplacement.



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(Continued from page 13)

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⁶ Larry H. Addington, *The Patterns of War Since the Eighteenth Century*, 2d edition, Bloomington, Indiana, Indiana University Press, 1994, page 260.

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ENFORCE Breakout Sessions Tackle Regimental Issues

By Lieutenant Colonel Susan Myers and the ENFORCE Team

Have you ever wondered what really happens at an ENFORCE conference? Breakout sessions held throughout the conference are part of an Engineer Regiment initiative to pull together all of the experience, great ideas, and issues discussed at the conference. The feedback generated from these sessions is then incorporated into the Engineer Regiment's strategic plan. Eight sessions were conducted during ENFORCE 97: Doctrine Development, Trend Reversal and Engineer Qualification Tables, Heavy Division Engineer Redesign, Light Engineer Force Structure, ACE and SEE Readiness, Integrated Concept Team (Combat Heavy), Bridging, and Countermining Concept.

Breakout sessions provide a forum to inform personnel about ongoing schoolhouse initiatives, solicit feedback, and formalize strategic planning efforts for issues critical to the regiment's success. This year participants selected the sessions they wanted to attend from the ENFORCE agenda and most came prepared for the discussions, which resulted in some lively debates. This was the first year that U.S. Army Corps of Engineers (USACE) division and district commanders participated in the sessions, and we intend to include more USACE topics next year. Highlights of the sessions follow.

Doctrine Development

By Captain Shawn Howley

The session concentrated on publications currently under revision. Feedback and insights gained from the discussion will provide a great resource for authors as they develop these warfighting manuals. Three manuals were discussed:

Joint Publication 3-34, Joint Doctrine for Engineer Operations. We discussed Chapter II, "Joint Engineer Fundamentals," which joint force commanders should consider when planning and executing engineer operations that parallel, support, or enhance the strategic goals and campaign plan. Attendees were invited to review Chapters II and III and

submit comments by 15 May. These chapters appear on the Engineer School's home page at <http://www.wood.army.mil/DDD/JOINT/joint.htm>.

FM 90-13-1, Combined Arms Breaching Operations. We discussed the breaching challenges facing commanders, the theory behind breaching operations, and the various types of breaching operations available to commanders. The group provided input on planned changes in breaching fundamentals and organizations that the author is making in the field manual.

FM 20-32, Mine/Countermining Operations. This manual provides U.S. armed forces with technical guidance for conducting mine and countermining operations and emphasizes maneuver and engineer staff planning and coordination. It will be used by all elements of the combined arms team.

Trend Reversal and Engineer Qualification Tables

By Captain Darrell Strother

We began with a demonstration of the "Trend Reversal" compact disc (CD) developed by the Engineer School's Combined Arms Branch. This user-friendly CD will help units reverse problem trends identified at the combat training centers by identifying some tactics, techniques, and procedures to correct them. The CD is scheduled for distribution via Internet by January 1998.

Resource issues dominated the discussion concerning the Engineer Qualification Tables (EQT) (see chart). The major issue was the Engineer School's position to constrain development of the EQT by the resources provided in DA Pam 350-38 (STRAC manual). No consensus was reached by the group, and we will continue to study the issue. Another point of discussion is apparent redundancy in the tables. Active Component units want to eliminate redundant tables. The Reserve Component units represented at the session want to maintain some redundancy to allow for both unit certification and qualification.

Comments gathered during the session will be used to revise the EQT. Draft copies will be fielded to selected units for comments, and the final EQT will be presented to the commandant for approval.

Heavy Division Engineer Redesign

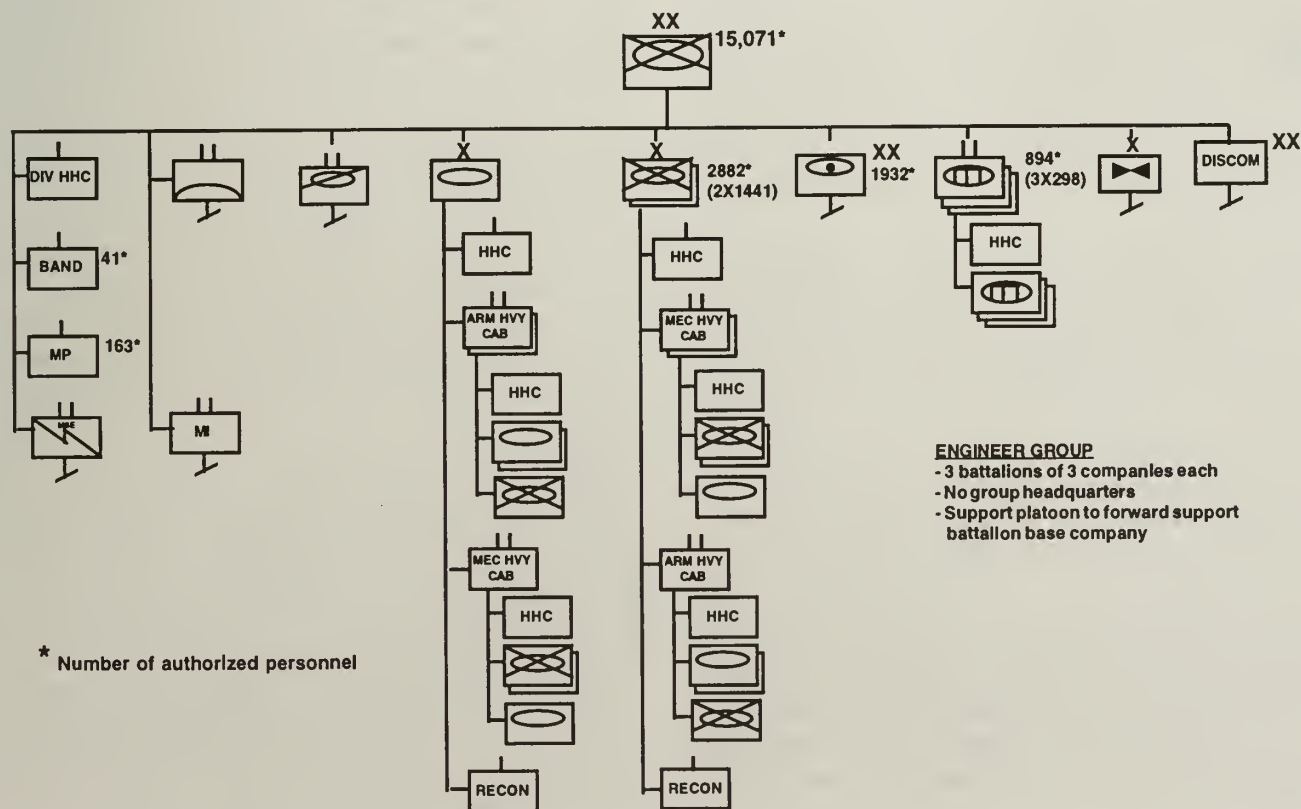
By Vern Lowrey

The engineer force structure is evolving to support the Force XXI heavy division. The conceptual heavy division engineer design includes Bradley fighting vehicles, Grizzly breachers, and Wolverine heavy assault bridges. The design also includes some fixes to the current heavy division engineer battalions, such as the addition of an S2 officer, a battalion maintenance officer, and a robust engineer reconnaissance capability. The battalion will focus exclusively on support to obstacle breaching operations. Extensive reinforcement from engineers at echelons above division will be required for other engineer functions.

During the ENFORCE Conference, TRADOC announced a decision by the Army Chief of Staff to provide three engineer battalions in support of the three maneuver brigades in a "conservative heavy division" design (see chart below). This design does not include a separate division engineer brigade or group command headquarters. The conservative heavy division design will be used during the Division XXI Advanced Warfighting Experiment (AWE) at Fort Hood, Texas, in November. It and two other designs (strike division and brigadist division) will be analyzed by the TRADOC

Engineer Qualification Tables	
Number	Title
I	Individual/Crew Weapons Qualification
II	Leader Demolitions and Mine Qualification
III	Individual Demolitions and Mine Certification
IV	Individual Demolitions and Mine Qualification
V	Preliminary React to Contact
VI	Preliminary Training Course
VII	Intermediate Certification Course
VIII	Intermediate Qualification Course
IX	Advanced React to Contact
X	Advanced Training Course
XI	Advanced Certification Course
XII	Advanced Qualification Course

CONSERVATIVE HEAVY DIVISION (as of 14 MAY 1997)



Analysis Command (TRAC) before the end of September, as part of the Division Design Analysis, Phase III, process. The strike division design includes an engineer group that commands six engineer companies. The brigadist division design attaches an engineer battalion to the maneuver brigade but has no engineer brigade headquarters. TRAC will analyze only combat capability (not battle command). The Engineer School will attempt to provide TRAC with needed battle command insights observed during the Division XXI AWE. This AWE will determine the need to retain the engineer brigade command structure in the heavy division.

The heavy division will require the capability to acquire and use an increasing load of digital terrain data to support Force XXI operations. We identified the need to manage digital terrain data at both division and brigade levels to provide needed terrain analysis and terrain evaluation support for the Army Battle Command System. Current Force XXI experiments show that terrain analysis teams equipped with Digital Topographic Support System equipment are required at both the division and maneuver brigade levels.

Light Engineer Force Structure

By Peter Malley

Redesign of the light force structure was the main topic of discussion. Rather than make small fixes, we agreed to fix what is broken throughout the light force. By doing this, we will examine the total force requirement to determine units that are no longer required or where missions may be reassigned to acquire "billpayers" to fix broken units.

Much discussion occurred when we displayed the engineer support structure programmed to light forces. All attendees understood the type of support units will receive when they go to war. We explained how doctrine drives their requirements in the total force and that we will correct the doctrine if necessary.

We discussed changes proposed by the light community and agreed to work with the 20th Engineer Brigade, Fort Bragg, to develop a concept for submission during the Force Design Update Process (scheduled for summer 1998). Engineer division commanders expressed concern about possible changes to the engineer light equipment company. They feel this unit is in good shape and should not change.

The Engineer School will continue to work with the 20th Engineer Brigade on proposed changes to the light force structure.

ACE and SEE Readiness

By Major Lewis Setliff III

The diverse audience included equipment users, commanders, and representatives from the Marine Corps, Theater Army Area Command (TAACOM), and the manufacturer. Our objectives were to—

- Provide commanders with systems to improve readiness.
- Update trends and acquire field input.
- Distribute a CD-ROM about M9 ACE maintenance.

We discussed initiatives in training, supporting, and operating the ACE and SEE that will increase their operational rates. We described current training requirements; maintenance techniques; and future initiatives on parts acquisition, operator and mechanic training, and doctrinal employment. Specific comments follow.

Training teams. The Army no longer funds maintenance and operator training teams—that is now a unit-level cost. Commanders reported that the teams are worth the cost and effort. While the operational readiness rate may drop immediately after a training team visit (due partly to increased knowledge of the operator or mechanic), overall rates soon should rise.

Schoolhouse focus. The Engineer School will remain focused on training and organizational support. Training includes required operator, mechanic, and sustainment training. Organizational support adjusts appropriate TOE/TDA levels to support equipment. We agreed that the organizational structure needs improvement and training needs frequent adjustments, but current initiatives adequately address these issues.

ACE CD-ROM. The CD-ROM for M9 ACE maintenance was demonstrated and issued to attendees. It was well received and should be a tremendous asset to units.

ACE system-unique parts. We must improve the readiness of this equipment and "pull" information from the user on why equipment fails. Users should complete in detail the data sheets that accompany parts orders so that materiel developers know why a piece/part failed (operator error, malfunction, or mechanical error). This information is critical. Units must document problems properly to weight the effort in resolving systemic problems. Materiel developers should apply the requirement for each part to meet the "form, fit, and function test," and those present agreed that user feedback will assist in this effort.

Local purchase of parts. Local purchases do not create a demand on the Defense Logistics Agency (DLA) and therefore adversely impact supply availability. DLA *must* be aware of our actual demand.

Reduced prescribed load list (PLL) initiative. Reduced PLL may adversely affect ACE/SEE readiness due to their low density and operational requirements. We must closely monitor parts availability and their effects on readiness and consider an exception to policy.

Special tools and equipment. The availability and function of special tools and equipment impact readiness. TAACOM will soon propose that special tools, such as those for the ACE and SEE, be part of a kit, outfit, or set.

Direct support (DS) maintenance operations. DS-level maintainers must not be left out of the loop for maintenance training, special tools, and enhancements such as the CD-ROM.

Integrated Concept Team (Combat Heavy)

By Major Shep Barge

This session described the purpose of the construction integrated concept team (ICT) and discussed the needs and desires of combat heavy and construction engineer units in the field. Major conclusions follow.

Procurement

- Most participants urged us to maximize the use of commercial construction equipment to accelerate the acquisition process and improve parts availability throughout the life of equipment.
- Participants agreed that the SEE is not suitable for combat heavy units. They want a sturdy, commercial backhoe in its place.
- Contractor/vendor support is necessary for any deployment. Interaction with vendors would be easier if all construction equipment was from the same company (however, contracting laws do not allow this). One participant noted that he was unable to use his International Merchant Purchase Authority Card (IMPAC) while deployed to Bosnia. The loss of this productive tool made it difficult to obtain repair parts for construction equipment.
- Units are frustrated that fielding plans for construction equipment often are lengthened because of the need to convert commercial manuals to Army standards. They agreed that new equipment should be fielded as soon as it is physically available, even if that means fielding with a draft manual. Participants agreed that paper manuals are still needed but that manuals on CD-ROMs should be distributed to encourage their use.



Palletized loading system transporter

Combat Developments

We discussed the concepts and particulars of upcoming construction equipment. The palletized loading system (PLS) received almost universal praise as a tool that will pay huge dividends for engineers (see photo). One dissenting opinion was concern that having the same PLS transport chassis as the rest of the Army would set up engineers to have their PLS trucks taken by the corps commander to support high-priority logistics missions. It was noted that the reverse is also possible: Engineers could receive assets from other units to help during high-priority engineer missions.

Bosnia Lessons Learned

LTC Mike Biering discussed his 6-month tour in Bosnia as commander of the 62nd Engineer Battalion (Heavy) and provided the following lessons learned:

- The deployment was complicated because the entire battalion is not stationed at the same location (split basing). SIDPERS (Standard Installation/Division Personnel System) reports were submitted to two separate installations for the entire deployment. Unit status reports and METL development should be improved to make it easier for geographically separated parts of a battalion to deploy as one cohesive battalion.
- E-mail systems between supported units and deployed supporting engineer units differ. A solution is to gather information about connectivity prior to deployment.
- Geotextile fabric continues to be extremely valuable for soil and road stabilization purposes.
- The 62nd Engineer Battalion sustained 24-hour operations because traffic and civilian movement were low during night hours. Despite the reduced visibility of working at night, the lack of traffic on the roads made night operations efficient.
- Reuse of materials from decommissioned base camps was a big success and reduced expenses in subsequent projects.
- Daily use and modification of risk assessments keep soldiers safe!

The interchange of information between materiel developers, field users, and Engineer School integrators is critical to providing timely and meaningful support. The results of this session will help maintain engineer effectiveness into the 21st century.

Bridging

By Captain Dan Guilford

The session opened with a brief introduction about the future of bridging. We discussed several doctrinal questions to help guide the development of future systems. The three most important questions were how to order replacement bridges, where to place unused components, and how to account for bridges. We came to a consensus on the first two questions and determined that the third requires further discussion.

The future of bridging incorporates units designed to emplace both fixed and float bridges. These units are no longer tied to their bridges; they can continue forward and maintain the momentum of the maneuver force. The PLS compatible bridge loads make this possible by enabling bridges to become commodities.

Engineers can manage bridges either by the total bridge or by individual loads (flatracks). Everyone agreed that we need the capability to order total bridging for corps and higher elements to provide bridges for the theater. Once in theater, units below corps level need the capability to manage bridges by loads. This capability allows planners to quickly order large quantities of bridges for transport into a theater while providing the flexibility to manage assets to a specific gap.

The group agreed that all components of any load used in construction should remain on site (to include flatracks). The potential exists to waste some assets when a unit uses only a few pieces from a load. However, as we replace those bridges with more permanent structures, units can easily inspect and repalletize the loads if all components are on site. This capability allows units to quickly place loads back into the supply system without an additional logistics burden.

We did not determine how to account for bridges. Whether during war or peace, engineers need an organization that tracks and is accountable for the location of each load and bridge. Units that install bridges will not remain at the bridge sites, and follow-on units probably will replace those bridges with more permanent structures. Units that install bridges lack the capability to maintain accountability.

One suggestion was for the multirole bridge company (MRBC) bridge park to maintain accountability for all bridges in a specified area. It was noted that the MRBC bridge park has limited assets and is not designed for that mission. However, the option exists for the maneuver

commander to organize a bridge resupply point (such as a Class IV/V point) from internal assets. Another suggestion is to transfer accountability from the emplacing unit to the engineer headquarters responsible for that area and later task responsibility to the unit designated for main supply route maintenance. As units move, bridging assets would transfer to the replacement units.

The information gathered in this session will greatly assist efforts to palletize existing and future fixed bridges onto flatracks. We will continue to discuss doctrinal questions about bridging assets as they arise.

Countermining Concept

By Lieutenant Colonel Brigid Ockrassa

A diverse group of materiel developers, project managers, combat engineers, Marines, and allied officers gathered for a successful session. Each attendee was given a copy of the draft countermining concept document. Since most of the topics were new, discussion and feedback were minimal. However, attendees were favorably impressed by the scope and depth of the document and will provide comments to assist with the review process. The stated objectives for this session were to—

Explain the new countermining concept and develop advocates to aid in its implementation. The concept was developed by the TRADOC Countermining ICT, which formed in June 1996 to examine countermining issues and propose solutions. In the concept document, issues address the DTLOMS categories and the future operational capabilities of a force operating in a mined environment. The concept document is being staffed throughout TRADOC and is expected to be forwarded to Headquarters, TRADOC, in July.

Obtain input regarding the feasibility and completeness of new ideas in the concept. The participants' biggest concern was resourcing. The countermining concept calls for better equipment, expanded fieldings, increased training, and greater countermining responsibilities. This concern is not new, but it doesn't preclude the ICT from articulating the objective endstate, which is not resource constrained. The Army's ability to achieve that endstate will be influenced by fiscal constraints.

The Canadian representative compared our concept to one they are writing and intends to incorporate many of our ideas in it. The Marine Corps representatives liked the way the concept involves the entire Army and saw potential for this to influence all ground operations. They requested to participate in the countermining ICT and have become active members.

Session participants were given an in-depth presentation on ways to apply risk management to countermining operations, in much the same way that it is applied to aviation. Engineers
(Continued on page 25)



the slavonski BROD crossing site: a multinational effort in Bosnia

By Captain Anthony G. Reed

In May 1996, the two U.S. float bridges in Zupanja were removed from the Sava River, leaving only the repaired fixed bridge in Brcko, in the northeast sector, connecting Bosnia-Herzegovina to Croatia. To save several hours of driving time, Task Force Eagle (1st Armored Division +) tasked units to develop a crossing site to link Slavonski Brod, Croatia, with Srpski Brod, (formerly Bosanski Brod), Bosnia-Herzegovina. The new bridge site would improve efficiency for the Nordic/Polish (NORDPOL) Brigade's convoys and help set the stage for the redeployment of the Implementation Forces (IFOR).

This article describes the crossing site mission, which was one of many where engineer units worked together to provide a wide range of engineer support to Task Force Eagle during Operation Joint Endeavor.

The Mission

A Hungarian engineer (PMP) float bridge company was tasked to emplace the bridge, and the 16th Engineer Battalion (Corps) (Mechanized) was tasked to clear and proof three boat ramps where the bridge was to be emplaced. The 16th Battalion's B Company organized and controlled all required assets and coordinated with the NORDPOL Brigade and Bosnian Serb engineers to have the Serbs clear their mines before we proofed the area. Based on reconnaissance, we took the following equipment and personnel:

- A Panther, a remote-controlled M60 tank with mine rollers used to detonate all types of mines (see article on page 24).
- A miniflail, a small remote-controlled, tractor-like machine used to detonate antipersonnel mines.
- An M88 recovery tank, to recover the Panther and use as a control vehicle.
- Two squads of combat engineers with M113A3s, for detecting, marking, and destroying mines.
- Five-ton dump trucks, for hauling fill material.

On the southern shore of the river, the west, center, and east ramps were potential crossing points. Records showed that minefields were on or directly beside all three ramps. The center ramp was our first priority, since no mines were on it. We only needed to construct a 30-meter road to connect the ramp to an existing parking area, which would serve as a holding area for future convoys. The west ramp was our second priority, because it had the most gradual slope and was twice as wide as the others.

At the proposed crossing site, we occupied an abandoned fuel tank farm that consisted of one large building and a huge, fenced parking lot. The building was wrecked and uncleared, so we set up tents to live in and secured the area.

The Hungarian float bridge company was across the river in Croatia. Since Croatia is a nonaggressive state, the Hun-

garians built the bridge there and secured it parallel to the river bank.

The Hungarian float bridge is the Former Warsaw Pact PMP bridge. It is similar to our assault float bridge (AFB) except that the PMP is steel, while the AFB is aluminum. In addition, the PMP can be split in half lengthwise to double the span for one-way traffic, although this significantly reduces the bridge's military load class. The PMP is assembled in the water very much like the AFB.

Proofing

We began proofing with the Panther near the center ramp, which was in a field about 30 meters southwest of the parking lot. The entire field had to be proofed because of the way the Hungarians had anchored the bridge. Rather than use an overhead anchorage system, they had tied cables from the bridge to bridge trucks parked on the shore.

The Panther's brakes weren't strong enough (via remote control) to prevent it from slipping into the river while proofing the ramps, so we used the M88 recovery tank as a control vehicle at the top of the ramp and connected the Panther to it with cables. We eased the Panther about halfway into the water with the cables, then reeled it back. Maintaining substantial overlap, we moved the Panther over slightly and repeated the process.

We proofed the field several times to ensure that it was clear of mines. The only area we didn't proof initially was directly to the right of the ramp, because minefield records indicated that 12 TMA-4 antitank mines were there. Our orders were to wait for the Serbian engineers to destroy those mines. They placed a small block of explosive with a blasting cap and time fuse next to each mine and blew them in place.

The Serbs cleared the center and west ramps, and we cleared the east ramp. We visually located three TMM-1 antitank mines and one PMR-2A antipersonnel mine. We placed half a block of C4 next to each and blew them one at a time.

The Panther could proof in all the areas where mines were destroyed, so we didn't need the miniflail. However, in mud such as that encountered near shore, the Panther's desert-type mine rollers tended to push a mine around rather than trap it between two hard spots and detonate it. We found a TMA-5 antitank mine in the mud where the Panther's rollers had stopped without detonating it. Later, as we reeled the Panther out of the water, its track picked up another mine embedded in mud. Most of the mud and the mine fell onto the ramp. But when we moved over to make another pass, the Panther's track solidly wedged the mine against the concrete ramp, causing it to detonate. Damage to the Panther included the following:

- Two sets of road wheels, three road wheel arms, and a shock absorber and mount blew off.
- The torsion bar bent.
- The transmission housing cracked.

Four days later, the Panther was repaired to a fully mission-capable status, and we continued proofing.

In areas where we couldn't proof mechanically, we used mine detectors and probes and discovered three antipersonnel mines. During proofing, our soldiers wore their flak vest and BASIC (body armor set, individual countermine), which is Kevlar-lined protective pants, protective overshoes, and a reinforced face shield.

The Swedish explosive ordnance disposal (EOD) team, with its mine dog and bomb dog, marked the cleared paths through minefields and cleared the building in the parking area and a concrete bunker near the center ramp. They used colored fluorescent spray paints and wooden stakes to mark cleared footpaths through the minefields. Each color meant something different; for example, blue may mean that an area had been cleared by a mine dog, while red may mean it was probed by hand. This is a great technique because the proofing results are highly visible.

The Finnish EOD team removed small trees and brush from under the water to ensure a clear path to the west ramp. The team packed explosives into a U-shaped channel of aluminum, in much the same way as we make an expedient Bangalore torpedo with a U-shaped picket. Then they floated out near the trees on a rubber raft and emplaced the charges in the water. Initially, they placed the channels of explosives vertically beside the trees, facing the trunks. Later, when most of the tree tops were gone but some roots remained, they laid the charges into the river bed and gently tamped them into the mud. This was extremely effective.

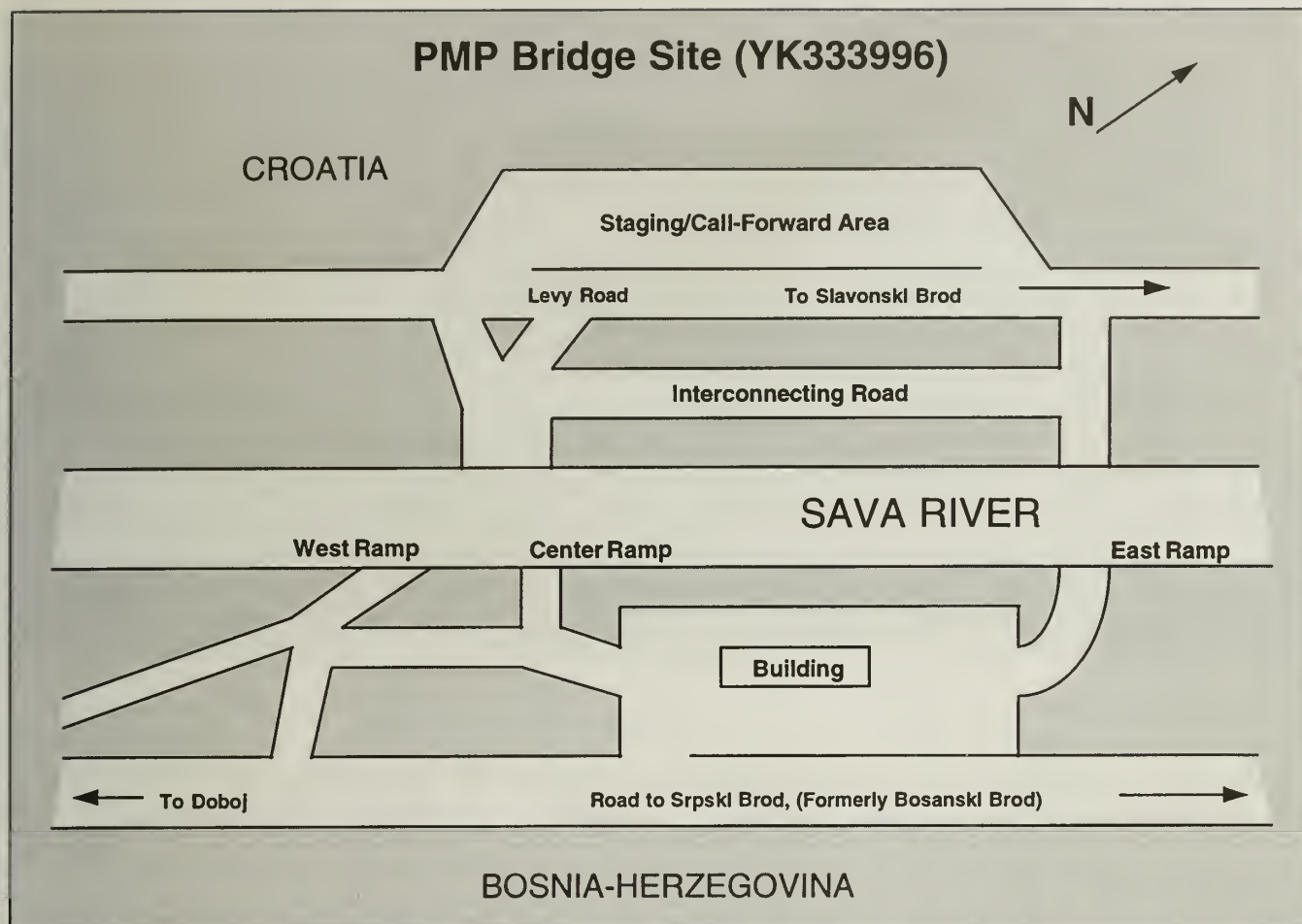
Bridging

When the center ramp was cleared and proofed, we emplaced the float bridge. Security was critical because the bridge site had to be protected from terrorist activity from both the southern and northern shores. It was the first time in four years that a bridge had been emplaced in this sector. Sabotage and a Serbian crossing into Croatia were two of our biggest concerns. Therefore, we reinforced the fence around the parking lot on the south side with triple-standard concertina wire and several manned gates. The north side was manned by Croatian police and Hungarian engineers. B Company engineers guarded the gates for the first five days until a Swedish mechanized infantry platoon assumed responsibility.

Although B Company engineers initially controlled traffic across the bridge, this responsibility soon was transferred to the 317th Rear Area Operations Center (RAOC), a small but extremely effective team. Fortunately, we worked well with them, because much of the traffic over the bridge was engineer vehicles.

We had to clear and proof the east and west ramps after the bridge was in place. We decided to do this while traffic crossed the bridge and close it only to detonate charges. However, it became increasingly difficult to coordinate all the proofing and demolitions with the large volume of traffic and the number of

PMP Bridge Site (YK333996)



visitors to the site. Then demolition operations became more complex as the Serbs and the Finns also began clearing. Again, the 317th RAOC worked with us to coordinate demolitions so as to maintain the safety of everyone involved.

Further Proofing

As the river receded, additional proofing was necessary on the newly exposed shore next to the ramps. We had to ensure it was safe in case a soldier disembarked near the bridge entrance or exit.

Explosions off the west ramp by the Finnish EOD team caused an underwater mine near the center ramp to detonate. So the Hungarians wanted us to proof with the Panther again, especially on the center ramp. We placed an armored vehicle-launched bridge (AVLB) over the water, then walked onto the bridge and lowered charges into the water on each side of the ramps. We detonated four such charges, but there were no more sympathetic detonations.

Horizontal Construction

Since we controlled traffic across the bridge, we could combine the staging areas and call-forward areas.

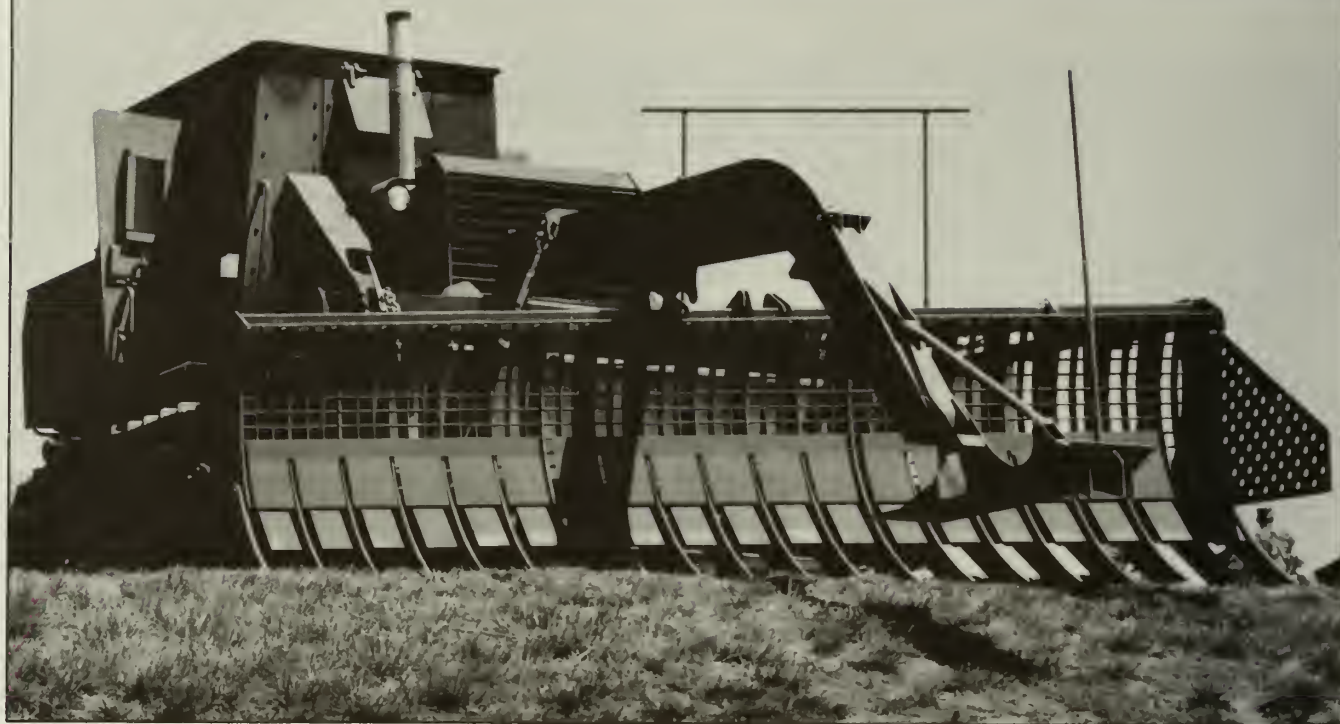
North Side Layout. The north side of the crossing site

needed an area to stage and call forward vehicles waiting to cross the river. Access to the site was via a narrow road surrounded by woods on top of an earthen levy. Three ramps, called the west, center, and east ramps, corresponded with those on the southern shore. The west and center ramps on the north side were so close together that a bridge could span from the southern center ramp to either of them (see figure). The 2d Platoon of the 535th Combat Support Equipment Company cleared and constructed a staging/call-forward area just north of the levy road, since the area had a separate entrance and exit. The platoon also connected all three northern ramps with a road wide enough to include a staging area for priority traffic.

South Side Layout. On the south side, the abandoned fuel tank farm, with access roads constructed by the 535th, could be used for a staging/call-forward area. Several enormous petroleum product and storage plants with extensive road networks and parking lots about three to five kilometers to the northeast would facilitate at least two staging areas.

Ramp Improvements. As the river continued to recede, it left a significant drop-off where the ramps ended. A platoon from the 535th hauled in large quantities of fill and

(Continued on page 32)



Robotics Insertion Technology

By David G. Knichel

Engineers are leading the way into the 21st century by inserting robotics into many existing and soon-to-be-fielded systems. As a result, the Corps of Engineers will be the first ground robotics branch in the Army. Robotics are already being used by combat engineers in Bosnia and will soon be available to many more soldiers, sailors, airmen, and marines when the first robotic systems are fielded in FY99.

Background

Industry has been investing in robotics for most of the latter half of the 20th century. Robotics began with simple manufacturing tasks and has progressed to the sophisticated human-like android capabilities being developed in Japan. Robots offer efficiency, a replacement for human labors, and an opportunity to remove people from hazardous environments, such as environmental cleanup, space and underwater exploration, fire fighting, and military operations.

In the military, robots were first used by the German army in World War II. Simple remote-control devices for mine breaching protected the lives of their soldiers. Today, U.S. organizations are advancing robotics technologies in the Army. They include the Defense Advanced Research Project Agency, Army Missile Command, Army Research Laboratory, the Office of Naval Research, Sandia National Laboratories; universities such as Massachusetts Institute of Technology and the University of California at Berkeley; and countries such as Germany, France, Italy, and Israel.

Technology

The essential sciences to robotics include mechanical engineering (ME), sensor technology (ST), artificial intelligence (AI), and computer science (CS). ME allows robots to be mobile and perform tasks, ST allows them to learn about their environments, AI allows them to "think" and "make decisions," and CS allows

them to process information. These sciences have made tremendous advancements in recent years, and a practical "thinking" autonomous robot may be a reality in the next decade. Until then, robots must operate in fixed-closed environments, such as assembly lines in industry, or humans must do the sensing, such as seeing and thinking, for them. The latter has been termed *teleoperation*.

Joint Development

In 1989, Congress directed the Department of Defense to consolidate its robotics efforts to improve efficiency, reduce redundancy of efforts, and accelerate robotics development. In 1994, the Joint Program Office for Unmanned Ground Vehicles (JPO-UGV) was established at the Army Missile Command's Redstone Arsenal at Huntsville, Alabama, as the singular managing agency for unmanned ground vehicles. To execute its joint mission, JPO-UGV is commanded by a Marine Corps colonel who is supported by

Army program managers. In 1995, an agreement between the Army and the Marine Corps gave the Army the lead as the joint development agency for unmanned ground vehicles. As a result, the Robotic Technology Insertion Activity (R-TIA) was also established at the U.S. Army Engineer Center, Fort Leonard Wood, Missouri.

Insertion Technology

When the U.S. Army deployed to Bosnia in 1995, it encountered more than a million land mines. In response to this, R-TIA and the JPO-UGV developed a prototype remote-control system that could be inserted in turretless M60 tanks outfitted with Israeli tank rollers. The Army built six of these systems, which were named *Panther* (see article on page 21). Their usefulness quickly became apparent as did the need for a standard robotics kit.

In March 1997, the commandant of the U.S. Army Engineer School approved the insertion of teleoperation robotic technology on engineer equipment. The impact is that approximately 20 percent of all dozer-type systems will have teleoperation robotic capability. In addition, other robotic systems, such as an improved prototype *Panther* on an M1 chassis, have been developed by R-TIA and are being tested (see cover photo).

A robotic soldier assistant, called the Robotic Combat Support System (RCSS), is also being evaluated at R-TIA. RCSS is the ideal small robot for our reduced military force. With RCSS, one person can lift, transport, or do the work of several. This is possible because of its multitask attachments (including a minibucket loader, mini-forklift, and hydraulic tool power cell) and its ability to clear mines (such as antipersonnel land mines). An improved prototype RCSS, with a mine flail capability, was sent to Bosnia on 17 June 1997. Older prototypes of the single-use miniflail system have been used in Bosnia since 1996.

User Appraisals

Today, R-TIA is combining a mix of robotic technologies with current and future vehicle platforms and allowing users to evaluate them in the development and preproduction phase. User appraisals allow the combat developer and program manager to get early user feedback from soldiers long before the systems go into production. Thus, problems are fixed before the systems are fully developed.

Fort Leonard Wood is an ideal location for the R-TIA joint service robotics appraisal site due to the presence of engineers from all services. Army, Air Force, Navy Seabee, and Marine Corps engineers have shown great interest in participating in the next round of robotics appraisals beginning 1 October 1997.

Conclusion

The robotic M60 *Panther*, which was fielded to the Corps of Engineers to clear land mines in Bosnia, is the most successful robotics ground vehicle to date. However, it is only the beginning of new robotic capabilities for combat engineers. Rapid developments in robotics insertion technology allow joint forces to upgrade the existing fleet of equipment for the 21st century at a much lower cost than replacing it. We have learned from Bosnia that inserting robotics technology gives commanders the capability of removing soldiers, sailors, airmen, and marines from the most hazardous missions in both war and host-nation assistance.



Mr. Knichel is the senior Robotics Systems Analyst at R-TIA. A retired combat engineer officer, he has worked with computers, artificial intelligence, and robotics for more than 10 years. Mr. Knichel designed some of the early robotics testing, such as the mine- and booby-trap-hunting ANDROS, deployed to Haiti to support the 10th Mountain Division. Mr. Knichel is a graduate of CGSC and has a master's degree in information systems.

(Continued from page 20)

need tools to quantify the risks associated with mines and various countermining systems for their maneuver commanders. After a thought-provoking discussion, the audience expressed interest in developing an artificial intelligence system.

Conclusion

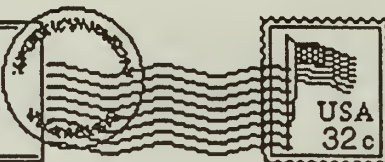
Breakout sessions are one of many opportunities for the Engineer Regiment to focus on important issues affecting the future engineer force. The 18th Airborne Corps engineers' quarterly video television conferences and the Engineer School's council of colonels provide other opportunities. As we expand our use of interactive media, we must continue to integrate issues into the regiment's strategic plan. The Engineer School's home page is a major conduit of information exchange, but nothing replaces face-to-face interaction and real-life examples. Thanks to all of you who took time to be part of the breakout sessions. Whether you attended the sessions or participate via interactive media, your contributions are valuable.

You can be part of the 1997 conference without leaving home by sending us constructive comments about the breakout sessions described above. Send comments to: Commandant, U.S. Army Engineer School, ATTN: ATSE-TD-TASS, Fort Leonard Wood, Missouri 65473-6650. The e-mail address is: Myerss@wood.army.mil.



Lieutenant Colonel Myers is chief of the Total Army School System, TRADOC, at the Engineer School, Fort Leonard Wood, Missouri. She previously served as executive officer, 1st Engineer Brigade and commanded C Company, 94th Engineer Battalion (Combat Heavy). LTC Myers holds a master's degree in business administration from National University, California.

Letters to the Editor



Death of the CEV

When I wrote the article, "Death of the CEV" (*Engineer*, December 1996, p. 17), I hoped to provoke conversation and thought throughout the Corps of Engineers family. Well, that has certainly happened and then some!

I received a phone call that I must share with all of my fellow engineers. The caller was the Project Manager—Abrams Tank. He shared the following information with me after reading my article in *Engineer*. I found it interesting that the Project Manager—Abrams reads *Engineer*.

He briefed me about all aspects of building a CEV on an M1 chassis with very limited modifications to the turret and hull of the M1. He informed me that, because the M1 CEV (for lack of a better name) requires such limited modifications to the hull and turret, all necessary work can happen at the depot level. This would drastically reduce the time required to get the updated CEV to the field. He estimated that once given a "Go," it would take about one year to build and begin testing the M1 CEV. After a production decision, we could build quantity rapidly.

The 165 mm demolition gun will seat into the basic M1 gun turret area, because the M105 main gun breach and the 165 mm gun are the same. When installed, the firing system probably will increase the accuracy range of the round significantly. The only major changes required inside the turret are to update the ballistic computer and replace the ammunition stowage rack system. The NBC overpressure system is not on the basic M1 but could be added to it.

An existing Israeli blade could be attached to the M1 chassis to give the M1 CEV a blade capability similar to that of the M728 CEV. This blade has been tested for use with the M1 chassis and could be installed at the depot level.

Finally, an upgrade to the M1 heavy suspension system is possible without any modification to the hull. The upgrade of the suspension system will give the chassis the same mobility as the M1A1 heavy and the M1A2. This upgrade will allow engineers to receive suspension repair parts from any tank unit they support, thus solving some of our recurring maintenance problems.

The cost of about \$900,000 for each M1 CEV prototype is minimal when compared with the cost of developing, testing, and fielding a new vehicle with the same capabilities. The ability to obtain repair parts and maintenance assistance from units the engineers support brings this engineer asset into the same vehicle generation as that of the maneuver forces.

The Project Manager—Abrams then informed me that the M1 hulls, the 165 mm guns, and the Israeli blades can be made available. So now, you ask, "When can we expect to get our 'new' CEV?" You will not believe the answer to this question: Probably never. The Engineer School is not looking to replace the CEV in this fashion, and we all know there is no move afoot to develop an M728 CEV replacement.

When told that the Engineer School appeared uninterested, I almost fell out of my chair! I cannot believe that we are not even considering this golden opportunity to replace a lost capability. As

a combat engineer battalion command sergeant major, I also cannot believe that we never heard of this proposal in the field and still would not know about it if not for this concerned soldier reading *Engineer* magazine.

All right, engineers, let's get on the phone, computers, or any other communications resource and let our Engineer School know how we feel. We need to address any possible method for replacing our lost CEV capability.

Command Sergeant Major Timothy Chadwick
4th ID, 299th Engineer Battalion
Fort Hood

Engineer School's Reply

CSM Chadwick's letter regarding a replacement for the M728 Combat Engineer Vehicle (CEV) raises issues that need to be understood by every senior member of the Engineer Regiment. His points are sound, and he has obviously done his homework. I will not refute his views about the need for a better CEV, because we need that capability. The question is how to meet that need. I offer another perspective about why the Engineer School is not working on an Abrams CEV at present. There are two basic reasons.

First, the world has changed since the original CEV was developed. Then the Army was focused on fighting a major war in Europe. The anticipated enemy had massive formations of armored vehicles, and we were significantly outnumbered and outgunned in many areas. Our strategy was to defend, trading space for time. We supported that strategy by becoming the best in the world at countermobility operations. Bear in mind that we planned to fight on terrain generally of our own choosing with which we were totally familiar. We were very well prepared for that eventuality. Mobility operations and the requisite equipment to support them were secondary to that primary focus. As a result, the Army did not see an overwhelming need for a dedicated complex obstacle breaching vehicle, like the Grizzly. There was support for an engineer capability to reduce point obstacles, such as that likely to be encountered in urban areas or obstacles created by nuclear strikes. There also was a secondary need for a capability to create obstacles from a standoff position. The M728 CEV was developed for that combined requirement.

Since then, the world has changed dramatically and the U.S. Army's role and anticipated missions have changed as well. Now we must be ready to deploy into areas of the world where opponents own the terrain and have ample time to prepare deliberate defenses. Potential opponents have had an opportunity to learn from our experiences in Europe. They are intimately aware of our countermobility doctrine, tactics, and equipment. While that change was taking place, we were not funded adequately to develop and field an effective counterobstacle capability. If our forces had been required to breach a complex obstacle against a credible foe who learned from our Cold War experiences in Europe, the results would likely have been grim.

The second reason, touched on briefly in the previous paragraph, is money. We have two mobility systems approaching fielding, the Grizzly and the Wolverine. They will provide world-class capabilities that no one else has. In the current budgetary climate, it is extremely difficult to get authorization to start a new acquisition program. The senior leadership of the Engineer Regiment has agreed on a list of priority programs for the future. We are addressing as many programs as resources permit. Unfortunately, a replacement for the CEV is not one of them.

In the meantime, we are seeking other ways to solve the problem created by the retirement of the CEV. The situation is not hopeless, and the Engineer School has not given up! The challenges of reducing point obstacles and providing engineer support to the combined arms team in close or open terrain are well understood. TRADOC, with Headquarters, Department of the Army support, is aggressively working on a near-term solution. The most likely option is to mount a rubble-clearing blade on the Abrams tank. A modified 120 mm tank round has proven to be effective against certain types of point obstacles.

For the long term, we're exploring several methods of delivering a demolition charge from a standoff position. The Grizzly, with its robust blade and arm, can clear rubble. While we may not have both demolition and clearing capabilities on the same platform, we will continue to accomplish the mission.

It is always good to hear from the field, especially on issues of great concern to the regiment. Thank you, CSM Chadwick, for setting the stage for this discussion.

Colonel Robert J. Greenwalt, Jr.
Director of Combat Developments

Loss of Antipersonnel Mines

The M16 bounding antipersonnel (AP) mine is a very effective weapon when employed properly. Lately, it and similar nonself-destructing "dumb" mines have become the center of U.S. policy because of their postwar impact on civilians. This has resulted in restricting their use to the Korean peninsula (*Engineer*, December 1996, inside front cover). Considering that the United States has approximately 1.5 million M16s in stock, we have a financial obligation to taxpayers to consider upgrading the M16 with a reliable self-destruct fuse, rather than destroying millions of dollars worth of government property. These mines could be fitted with a "smart" fuse similar to one developed by the Italians for their Valmara 69 bounding AP mine, called the VS-APFM1. This advanced electronic fuse can be programmed to self-neutralize in up to 365 days. However, it should be noted that the need for long-term nonself-destructing mines in barrier minefields like those found along the DMZ in Korea will continue.

Alternatively, the M16 could be used as a command-detonated munition similar to the M18 claymore (within the restrictions outlined in the Convention of Conventional Warfare) or it could form the basis of a command-activated, close-in vehicle defense similar to the one fitted to the famous German Tiger tank. Such a system effectively protects tanks from dismounts in urban combat (which may become more prevalent in the near future) or other restricted terrain.

Considering that the U.S. military has not performed very effectively against dismounted opponents in the last 50 years (Korean Conflict, Vietnam War, and Somalia) and that bounding AP mines are very effective against such threats, we should make every effort to upgrade this valuable resource to make it politically acceptable. They are too valuable a resource to waste.

Major William Schneck
ADE, 29th Infantry Division (Virginia Army National Guard)

Engineer School's Reply

MAJ Schneck is correct in his position that the M16 antipersonnel landmine (APL) is an operationally effective weapon. Its battlefield functions are vital to the success of U.S. war plans. Unfortunately, APLs are politically unacceptable and, as the letter states, nonself-destruct APLs have been banned. The U.S. military has the charter to find an acceptable APL replacement—one that fills the operational niche currently filled by APLs but does not pose a lingering threat to innocents. The letter suggests two possible approaches, which I will address.

Add a self-destruct fuse to the M16. The President's policy clearly articulates a goal to eliminate all APLs—not "dumb" APLs, not "smart" APLs, all APLs. Converting our nonself-destruct to self-destruct would violate the intent of the President's policy and be more fiscally irresponsible than simply destroying our current stock.

Add a mechanism to make the M16 a command-detonated munition. The Office of the Secretary of Defense is sponsoring a major, three-part study to find an APL replacement. It is a very comprehensive research project. In this unconstrained, brainstorming environment, we are considering all options across the DTLOMS (doctrine, training, leader development, organizations, materiel, and soldiers) domains. Options include lethal systems, nonlethal systems, expanding employment of currently fielded systems, increasing the force structure, and modifying existing mine stocks. To address MAJ Schneck's specific suggestion:

- The technical challenge of adding the control mechanisms that make APLs acceptable is not trivial.
- It is unclear what additional target verifications will be required to accommodate reduced visibility.
- The command and control and force structure implications of fielding this system are not obvious.

A TRADOC-chartered integrated concept team is now analyzing the effects of current APLs and determining the most tactically sound employment of candidate replacements. Research confirms that APLs provide many benefits to the warfighter. MAJ Schneck's letter touched on just one use of APLs—defending a long-term border from a dismounted threat. In that role, the APL essentially is a "robotic sentinel," filling a role not easily duplicated. The Department of Defense has invested a lot of time, money, and energy into the task of finding APL alternatives that address all tactical employments. We have not acted unilaterally. We have solicited industry and academia for possible solutions and are working closely with nations that are seeking politically acceptable systems that replicate the operational functions of APLs.

Replacing the functionality of APLs has proven to be an elusive challenge. Some innovative technologies are beginning to emerge. The bad news, however, is that the most promising replacement systems tend to operate in a narrow set of conditions and address only a single tactical employment. These systems are very expensive and they are years from fielding.

Bottom line: While we have not found the answer yet, we are considering all relevant options in pursuit of an appropriate APL replacement.

Lieutenant Colonel Brigid Ockrassa
Special Countermine Project Officer
Directorate of Combat Developments

Infrastructure Preservation: *Extending Road Life in Remote Areas*

By Major Robin L. Hagerty, George Mason, and Gil Mason

Recent humanitarian operations in remote areas of Africa and Bosnia have emphasized the need for a strategy to deal with road networks that cannot sustain enough logistics convoy traffic to support military operations. The traditional point of origin for equipment and materiel is a fixed seaport or airfield, with the final distribution point being at the end of an unimproved dirt road. This scenario requires repeated transloading of materials as route conditions and topography change.

Unimproved secondary roads are commonly built for light- and medium-duty wheel loads, with construction consisting of minimal subgrade preparation overlaid with gravel. Normal maintenance for these roads consists of periodic blading and seasonal applications of new surfacing materials. The subgrade's compaction, strength, and drainage determine the

frequency of maintenance needed to keep the road passable.

Initial road failure may be indicated when drivers complain about pot holes, surface rutting, and roughness. Road deterioration that causes vehicle vibration rapidly increases driver fatigue and limits the speed he can safely drive. At the same time, it accelerates vehicle maintenance requirements.

This article describes roadway deterioration caused by military transportation in remote areas and presents some actions that can extend road life.

Discussion

U.S. military relief missions often involve transloading supplies from large transport trucks onto smaller, Army series M923 trucks, which are better suited for use on unimproved roads. The repeated heavy-duty wheel

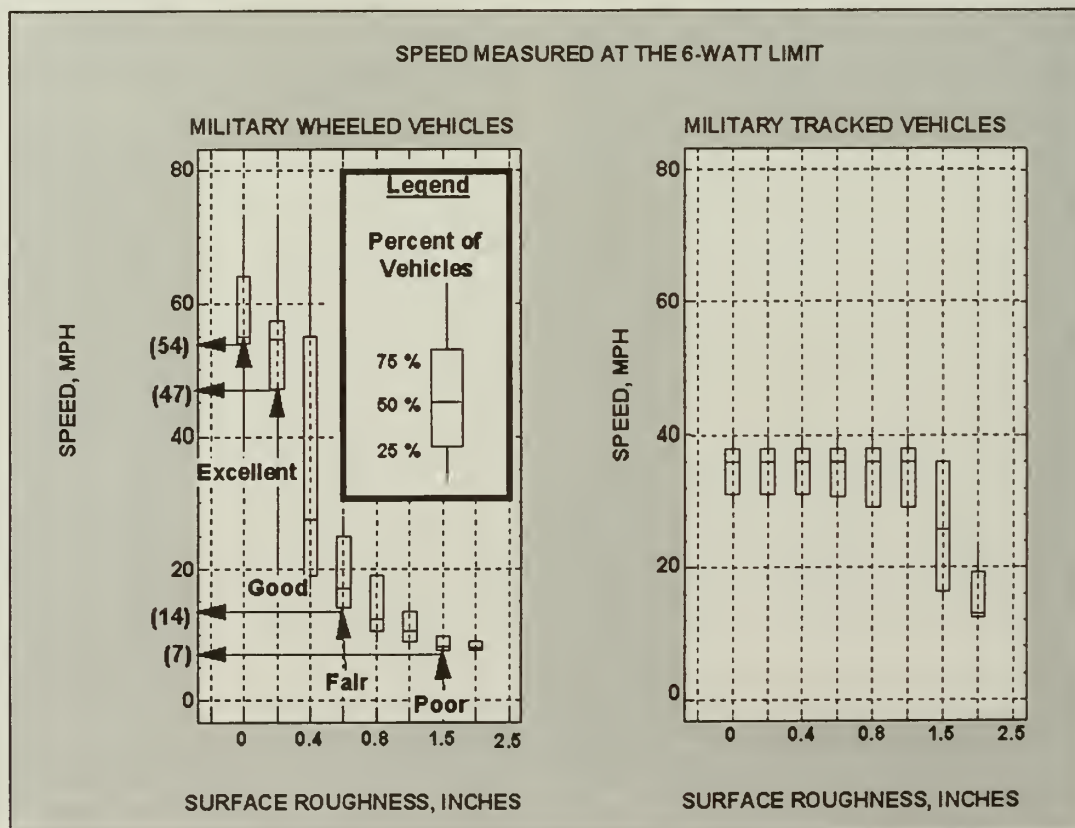


Figure 1. Relationship between vehicle speed and surface roughness of selected ride courses.



Figure 2. Estimated cargo movement time when speed is limited by road surface roughness.

loads from these trucks' bias-ply tires may immediately or cumulatively affect the roadway until deterioration makes it almost impassable. If tire pressure is high, the tire's ability to absorb many of the dynamic forces imposed by the vehicle traveling along an uneven road surface is limited. Thus, most of the dynamic force is transmitted directly down to the road and up to the driver.

Fatigue Level. The Human Engineering Laboratory at Aberdeen Proving Ground has taken the dynamic forces exerted on the driver over time and translated them into fatigue levels. Several vehicle-testing laboratories built courses to represent various levels of surface roughness existing in different areas of the world. Then military vehicles were driven over these courses, and on-board measurements were recorded. Vertical accelerations at the driver's seat (referred to as absorbed power) were averaged over time and defined in units called *watts*. Further research determined that drivers normally did not operate vehicles for long periods (8 hours or more) at absorbed power levels of 6 watts or more.

Speed. Figure 1 represents the relationship of speed and surface roughness for military wheeled and tracked vehicles tested on various ride courses. The x axis in Figure 1 ranges from a very smooth segment of road (no undulations) to an extremely rough segment (approximately 2.5 inches). Mason, Smith, Gray, and Ahlvin explain in detail this method of describing terrain and road surface roughness.¹

Using Figure 1 as a means of estimating speed for convoys, four conditions were selected to demonstrate the effects of different levels of roadway deterioration on convoy speed. The average convoy speed is defined at the 1st quartile, or the point where 25 percent of the wheeled military vehicles tested

is limited by surface roughness. Thus, a surface roughness of approximately 0 inch, with a corresponding average speed of 54 mph, represents extremely smooth roads in excellent condition. In the next quartile, roads in good condition are represented by a surface roughness of 0.2 inch, with a maximum speed of 47 mph. In the third quartile, a surface roughness of 0.6 inch, with most speeds reduced to 14 mph, represents roads in fair condition. Finally, a surface roughness of 1.5 inches, which may restrict vehicle speed to as low as 7 mph, represents roads in poor condition.

Wheeled vehicles were selected for the study since they normally comprise relief mission convoys. The doctrinal average convoy speed specified in FM 101-10-1, *Organizational, Technical, and Logistical Data*, is 40 km/hr (24.8 mph), which includes halts. The convoy is expected to travel 320 kilometers (198.4 miles) in 8 hours. Excluding time for stops, the vehicles will average speeds of 80 km/hr (49.6 mph). However, visibility, terrain, and road conditions often affect the average speed.

Figure 2 depicts the relationship between the increase in time required to transport supplies and the road condition. Calculations are based on the convoy traveling 200 miles with the speed restricted by the 6-watt fatigue maximum of the driver. Speeds given for the road conditions in Figure 1 are used to calculate the time required to move the payloads in Figure 2.

Soil Stress

Within the parameters of geotechnical engineering, it is convenient to view the subsurface soil stress as a function of stresses from—²

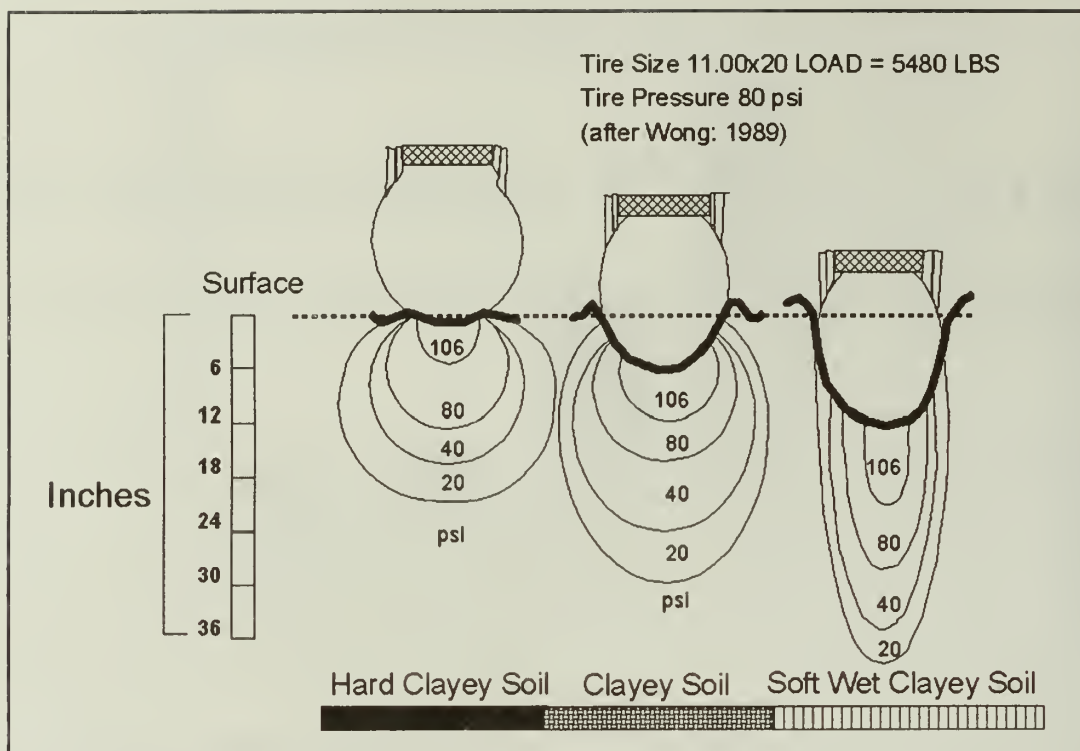


Figure 3. Pressure distribution under a statically loaded tire in various soil types.

- Soil and road surface weight (construction).
- Fluid pressures (weather).
- Externally applied loads (traffic).

Military transporters are primarily concerned with changes in road surface conditions that inhibit movement. Road deterioration normally occurs through interaction of the tire's footprint and the road's ability to absorb and disperse stresses imposed by traffic while maintaining its surface resiliency. Tire design helps the road retain some of its resiliency by absorbing part of the stresses. Without periodic maintenance, the road surface's ability to absorb load stresses is reduced, causing the surface and/or subgrade to fail. As failure continues, the road surface cracks and develops ruts. Rutting begins the chain of events that quickly makes the road difficult to travel at maximum speeds. As traffic accelerates, the deterioration process continues to increase and drivers must reduce speeds to prevent damage to vehicles, the cargo, or themselves.

Figure 3 depicts the distribution of radial stresses from a 5,480-pound tire load in various mediums. It shows the relationships between the passing wheel, its loading effects, rutting, and the dynamics of the passing shock wave as it penetrates the road's subgrade through different soil types.³ The cross-sectional view shows the downward stresses caused by the wheel as it traverses the road and demonstrates how these stresses are dispersed and absorbed by the subsurface soil.

The figure depicts the shock wave from an M923 cargo truck with bias-ply tires and its cargo centered over the rear wheels. The calculated front-wheel load (worst case) represents the net vehicle weight of 22,515 pounds, combined with its rated gross cargo capacity of 10,000 pounds, and divided by six wheel locations.

Figure 3 shows how different soil types respond to the wheel load but does not specifically identify the stresses caused by vehicle speed. This figure also shows the relationship between soil subsurface strength and the tire's ability to penetrate deeper into the subsurface, thus increasing the severity of rutting with each additional vehicle pass.

Alternatives

Engineers can calculate the effects of wear on unimproved roads; however, many transporters lack a background in using these analytical methods. For field applications, convoy planners need an engineer-developed methodology that is based on scientific principles. It should be easy to understand and simple to apply.

The relationship between a wheel load and its interaction on an unimproved road are predictable. Therefore, the transporter has several alternatives for preserving road life. These include reducing tire pressure, vehicle speed, and vehicle weight.

Reduce Tire Pressure. This action increases the size of the tire footprint and decreases the transmitted wheel-load stresses. It more evenly distributes stresses over a wider

tire-contact area. However, we must exercise caution when reducing tire pressure. Total reduction must not exceed 25 pounds per square inch (psi) per tire. If the pressure reduction drops below 25 psi per tire, excessive tire deformation may occur, resulting in damage to the sidewall or inner tube. Reducing tire pressure also lessens the driver's discomfort from road surface roughness.

Reduce Vehicle Speed. In conjunction with reduced tire pressure, a lower speed assists in more even distribution of shock waves through the soil. Reducing shock waves helps preserve the drivers' comfort.

Reduce Vehicle Weight. Decreasing the vehicle load offers the greatest potential for extending road life while preserving the drivers' comfort. When planning throughput estimates in remote areas, transporters normally use the cross-country load weight, which is approximately 75 percent of the vehicles' rated capacity, as a base calculation. Reducing the estimated cross-country cargo load from 7,500 to 6,000 pounds reduces vehicular-caused road deterioration.

The best potential for retarding road deterioration is to use a combination of all three alternatives. This common-sense approach can be broken into several independent actions. Transporters should apply the alternatives in response to changes in weather and road conditions to extend road life and lessen potential damage to their trucks' suspension components.

Figure 4 illustrates the net effect gained from these alternatives.

- Situation I reflects no action taken.
- Situation II reflects reduced tire pressure.
- Situation III reflects reduced tire pressure and reduced payload.

- Situation IV reflects reduced tire pressure and a reduced payload of 1,500 pounds below the normal cross-country planning load.

Calculations are based on research conducted at the U. S. Army Engineer Waterways Experiment Station, using an Army series M923 5-ton cargo truck with a cargo weight of 10,000 pounds.⁴ The wheel load was calculated using the vehicle's rated load capacity of 10,000 pounds and its manufactured empty weight of 22,515 pounds. As illustrated, Situation IV indicates the greatest potential for increased road life span. An interesting observation between Situations III and IV is that reducing the cross-country payload and reducing tire pressure significantly increases the life of the road.

Conclusion

The physical and political environments of a host nation influence the execution of military operations. Infrastructure limitations due to the remoteness of an area, combined with ever-changing political considerations, present unique challenges for our military forces. There is a direct correlation between road usage and road degradation and their effects on limiting convoy throughput operations. This correlation has significant influence on vehicle speeds, surface roughness, and vehicle maintenance. The alternatives discussed above are possible solutions to this problem. Reduced vehicle loads and tire pressures may potentially double road life. It is critical that military transporters understand the correlation between traffic and road degradation and between vehicle speeds and surface roughness.

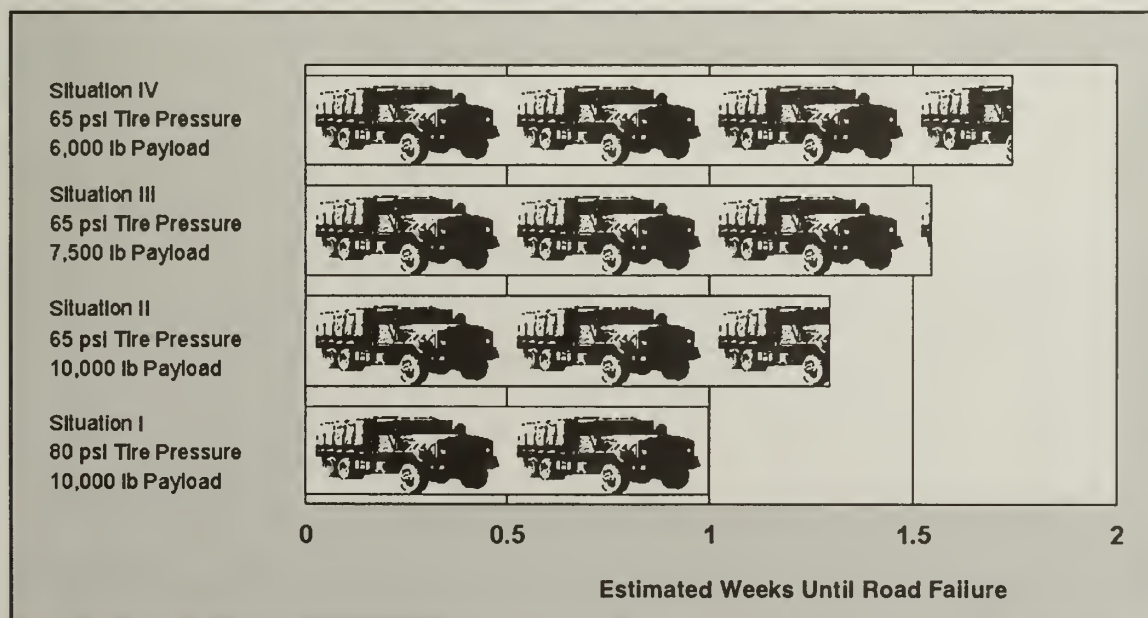


Figure 4. Estimated changes in road life based on vehicle configurations.

Engineers have limited assets for maintaining road networks. Therefore, military transporters must help reduce damage to roads in order to increase their longevity. As the focus of our force projections shifts toward humanitarian operations, more emphasis is placed on reducing overall operational costs and improving timely execution. Each member of the humanitarian team must strive to preserve the infrastructure while maintaining daily throughput operations.



Major Hagerty is deputy commander of the Nashville District, Corps of Engineers. She was previously stationed at the Waterways Experiment Station, Vicksburg, Mississippi. MAJ Hagerty holds a master's degree in civil engineering from the University of Texas at Austin and is a registered professional engineer.

Mr. Gil Mason is a researcher in the fields of military transportation and logistics for Applied Research Associates Inc., Vicksburg, Mississippi. He is a graduate of the Army Command and General Staff College and holds a master's degree.

Dr. George Mason is a registered professional engineer in the Mobility Systems Division, U.S. Army Waterways Experiment Station, Vicksburg, Mississippi. He holds a doctorate in civil engineering from Rensselaer Polytechnic Institute, Troy, New York.

Endnotes:

¹Mason, G.L., R.P. Smith, M.W. Gray, and R.B. Ahlvin, "Development of a Terrain and Road Data Base for HML Transporter Concepts" *Technical Report GL-85-12*, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. 1985.

²Cernica, John N., *Geotechnical Engineering*, Holt, Rinehart, & Winston, Inc. 1982, page 156.

³Wong, J.Y., *Terramechanics and Off-Road Vehicles*, Elsevier Publishing, 1989, page 198.

⁴Barber, V.C. and N.R. Murphy, "Vehicle/Road Compatibility Analysis and Modification Systems, (VRCAMS)" *Technical Report S-73-13*, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. 1973

Acknowledgment: The tests described and the resulting data presented herein, unless otherwise noted, were obtained from research conducted under the Research, Development, Testing, and Evaluation program of the U.S. Army Corps of Engineers by the U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. Permission was granted by the Chief of Engineers to publish this information.

(Continued from page 23)

lengthened the ramps so the float bridge's length could be adjusted to the water level.

Clean-Up Operations

After the Finns blew charges in the water to clear the foliage, they brought in an excavator to clean up roots and debris. To allow them to reach farther across the water, we laid out the AVLB so they could move the excavator onto the bridge. This was the second time we had used the AVLB in a nontraditional role.

The Finns had a bucket loader with a revolving street broom attachment, which we used to sweep the large parking lot. It is a very efficient and useful device.

Lessons Learned

Most important, we learned that engineers must maintain a wide variety of equipment to accomplish the myriad of tasks expected of them. This can be accomplished in two ways:

- Continue to task organize units as required to accomplish the mission. This may include equipment from other nations as well as U.S. assets.
- Tailor a battalion-sized unit to give it bridging, horizontal and vertical construction, and combat engineering capabilities. (Task Force Volturmo is a good example of how successful a diverse engineering unit can be. See article on page 2).

We also learned that there is a continued requirement for better countermine equipment. The Panther with its desert rollers was helpful, but it often failed to detect mines. Until technology provides us with that "ultimate" piece of countermine equipment, we must continue to use every tool available to reduce and eliminate the mine threat in every situation we encounter.



Captain Reed is attending CAS3 and will attend the University of Washington this fall. Previous assignments include Commander, B Company, 16th and 54th Engineer Battalions; and XO/platoon leader (during Desert Storm), 1st Engineer Battalion. He holds a bachelor's degree in industrial technology from Southern Illinois University.

Asphalt-Mixing Plants: Baghouse Operation Tips

By Staff Sergeant Jaime Barrientos and James E. Shoenberger

The U.S. military maintains a large volume of asphalt concrete pavement. In the Army alone, the volume exceeds 7,000 miles. Construction support units are responsible for asphalt concrete pavement construction for Army requirements, and these units possess a wide range of equipment, including an M081 Asphalt-Mixing Plant.

To avoid air pollution, controlling dust during asphalt mixing is a must. This article describes the function of and operational guidelines for a well-developed, efficient maintenance program for a baghouse, which is an air-filtration system that removes solid particles from the gas stream during asphalt mixing. This information will be especially useful to Army engineers involved in asphalt concrete mixture design or any pavement construction.

The U.S. Army Engineer School's 62H course, *Concrete and Asphalt Equipment Operator*, provides hands-

on instruction on the M081 Asphalt-Mixing Plant, along with other construction equipment owned by units.

Introduction

Asphalt concrete is blended aggregates held together by asphalt cement. Aggregates make up 85 to 90 percent, by volume, of the mixture. The aggregate materials normally contain at least a small amount of moisture, which must be removed before the aggregates are coated with asphalt cement. At ambient temperature, asphalt cement is a black, semisolid, highly viscous material. When heat is applied, it becomes a liquid and less viscous. Heating the aggregates and the asphalt cement in an asphalt-mixing plant removes moisture and liquefies the asphalt cement so it will adhere to the aggregates.

The two main types of asphalt-mixing plants—batch and drum mixers—have similar basic components. A typical

drum mixer is shown in Figure 1. Asphalt plants have a cold feed system to meter and deliver the aggregates to the plant. There the aggregates and asphalt cement are heated and combined into a homogeneous mixture. Among the emission control systems available that will capture particulate materials, the baghouse is the predominately used system. This method allows trapped aggregate fines to be returned to the mixture, thus minimizing changes to the original aggregate gradation. A properly maintained and operated baghouse system will remove almost all the fine aggregates from the exhaust gas stream, thus assuring that air quality requirements are achieved.

Baghouse Operations

Baghouse air-filtration systems operate by trapping small particles in a series of fabric filter bags, while hot exhaust gases pass through and are

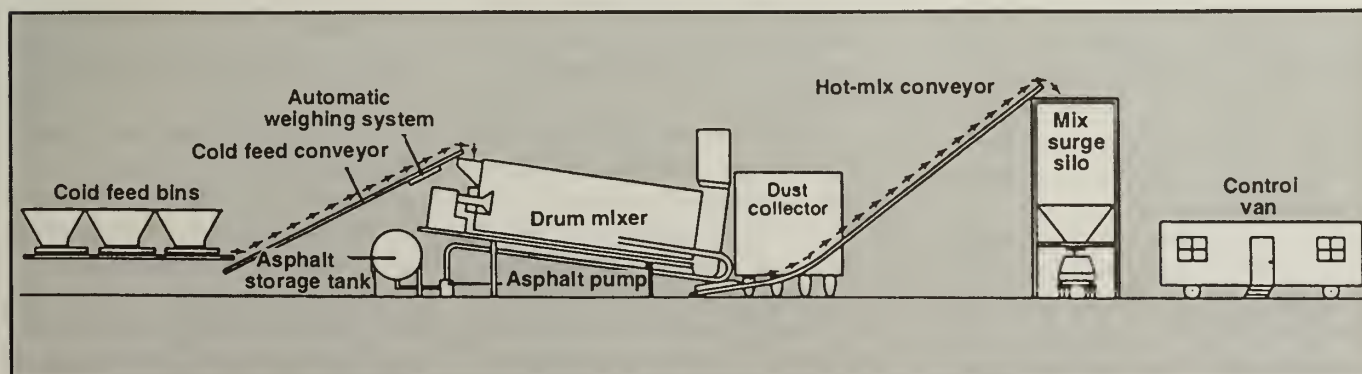


Figure 1. Basic components of a typical drum-mixer plant.

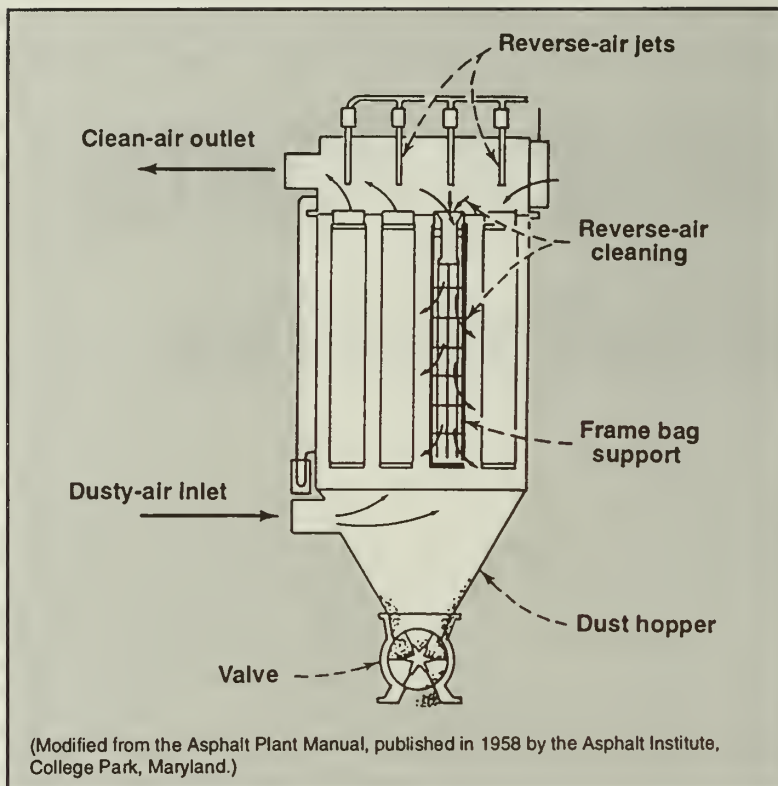


Figure 2. Typical layout of baghouse components.

expelled from the plant (see Figure 2). Most baghouse systems employ an expansion chamber or knockout box, which uses pressure differential methods to remove large aggregate particles from the air stream before it passes through the bags. The bags are attached to a circular metal framework in a series of rows or columns. As exhaust gases pass through the bags, the inside (or exhaust side) of the system contains relatively clean air. When operating properly, baghouse systems remove up to 99.9 percent of the fines in exhaust gases.

To ensure that a system continues to operate properly, the bags must be cleaned periodically. This is usually accomplished by shaking the bags, back flushing them with air, or by using a combination of these two procedures. If groups or rows of bags are cleaned simultaneously, the baghouse system can continue to operate.

The temperature of air passing through the baghouse is critical to its performance. Normally, the temperature of the exhaust gases should remain between 250 and 450 degrees Fahrenheit. If the temperature is too

high, synthetic material in the filter bags will be damaged. The efficiency of the plant may be impaired as the temperature drops below 250 degrees Fahrenheit, which is below the dew point (the temperature at which vapor begins to condense). At higher levels of humidity, condensation accelerates. Therefore, the natural environment (climate and season) existing during the mixing process also affects baghouse performance.

The condensation of moisture flushed from the exhaust gases has two major effects on the baghouse:

- Moisture condenses on the filter bags, which causes particles to adhere to them and form an agglomeration that prevents the gases from passing through the fabric. This condition can starve the production process for combustion airflow, greatly decreasing baghouse efficiency. Also, the agglomeration that forms is difficult to remove, making normal bag-cleaning procedures impossible. As long as the exhaust gas temper-

ature stays above the dew point, the exhaust remains a gas as it passes through the baghouse and exits through the stack.

- Metal parts of the baghouse corrode from sulfuric acid. It condenses out of the air stream when temperatures fall below the dew point. Condensation of the acid occurs at a higher temperature than water vapor, so the highest component dew point should be considered as the dew point for the exhaust gas stream.

Condensation is more prevalent during plant start-up, because the baghouse components are not hot enough to keep moisture and acid in the exhaust gas stream from dropping below their dew points. To ensure that the baghouse is properly preheated, the outlet temperature gauge should be monitored and no moisture (mixture materials) added until a satisfactory temperature level is reached. When water vapor is added to the gas stream as a result of the drying process, the gas stream temperature initially drops. A preheated baghouse will not allow the lower-temperature, moisture-laden exhaust gas vapor to condense into liquid. The following conditions will contribute to moisture development in the baghouse:

- Insufficient preheating
- Lack of adequate insulation
- Inadequate system purging after shut-down
- Introduction of moisture into filters through the compressed air-cleaning system
- In-leakage of moist ambient air

Note: A general rule of thumb is to operate the baghouse at 250 degrees Fahrenheit or higher and employ proper start-up and shut-down procedures. Keeping the temperature of the baghouse above the acid dew point will greatly minimize moisture and acid condensation.

The 62H course instructors recommend the following procedures to maintain and extend the service life of all baghouse components.



A soldier operates the M081 Asphalt-Mixing Plant from a control van. He is responsible for the operation and safety of the plant.

Start-Up Procedures

1. Preheat the system (without the drying aggregates) long enough to ensure that the components are hot. This phase may take 15 to 20 minutes or more. Note that gas going out may be hot even though the steel in the unit has not had time to heat up. If aggregates are introduced too soon, moisture from the drying process will condense on the cooler steel components and bags, causing the initial layer of dust to dampen and become impermeable.

2. After preheating the system, and without shutting off the fan, begin feeding the aggregates. If possible, start with a coarse mix so the amount of fine material collected in the baghouse is kept to a minimum. In addition, maintain a steady production rate for the initial start-up to build and maintain a good dustcake (light coating of fine aggregate). If possible, do not run full production for a few minutes to allow the dustcake to develop.

3. When feeding aggregates to the system, close the fan outlet damper to reduce the gas flow so the dryer "puffs" at the burner. At that time, slightly open the fan damper to stop the puffing. This setting will vent the dryer and minimize the amount of air required. At this point, fuel usage is minimized to near optimum conditions.

Shut-Down Procedures

After shutting down the operation, the air ventilation system will approach ambient air temperature and conditions as the heat generated from the process dissipates. Dew points will be reached and some condensation will occur. When moisture and acids form, they remain on the baghouse components until they evaporate or the process starts again. When nearing the end of a production cycle, use the following procedures to shut down the system:

1. Stop the feed to the dryer.
2. After the material is out of the dryer, switch the burner to low fuel or a lower firing rate and continue to run the dryer for 3 to 5 minutes. This "purging" action will ensure that any moisture-laden gases are evacuated from the baghouse and chemically active hot gases are not trapped in the baghouse as it cools through the acid dew point. Because purging removes these gases and the baghouse cools quickly, a minimum of condensation forms during the shut-down process.
3. Turn off the burner, but continue to run the fan for about 10 to 15 minutes to cool the system or until 160 degrees Fahrenheit is achieved. It often helps to continue the cleaning cycle during the cool-down period so that hardened or chemically active particles do not build up on the fabric. Stop the

cleaning cycle when the measured pressure difference between the dirty and clean sides of the baghouse falls below 3 inches of water column (15.6 pounds per square inch).

4. Remove the material from the dust collector so the unit is ready for start-up the next operating day. Do not store hot moisture-laden dust in the hopper because it can create material handling and start-up problems.

Engineering Support

The recommended start-up and shut-down procedures detailed above are a part of the information available from the team of instructors at the 62H course at Fort Leonard Wood. Additional information on baghouse operations is available in Technical Manuals 5-3895-374-10 and 5-3895-374-2.



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The GPS Computer-Based Tutorial

By Major Guy R. Mallow and Edward A. Forman

The Global Positioning System (GPS) revolutionizes navigation and positioning capabilities and soon will be integrated into everything the military does. The engineer community must learn how this technology works, so they can take advantage of it.

"The map, compass, and survey equipment in use will not provide the location and navigation information to the degree of accuracy and responsiveness required to support the combat user of fielded or emerging tactical systems." (taken from a DoD required operational capability document, revised in 1991) The 1994 funding appropriations bill passed by Congress states, "Funds may not be obligated after September 30, 2000, to modify or procure any DoD aircraft, ship, armored vehicle, or indirect-fire weapon system that is not equipped with a Global Positioning System receiver."

Why the GPS?

The GPS could be referred to as just another device that answers the age-old question "Where am I?" However, a user can expect seven times better accuracy with a GPS receiver than with a map and compass. Because of its accuracy, the GPS has replaced all previous positioning systems.

Many current and future devices used by engineer soldiers will incorporate GPS technology. An example is the more than 70,000 precise lightweight GPS receivers (PLGRs) fielded to the Army.

GPS technology also will be included in future minefield recording equipment such as the Digital Reconnaissance System and the Digital Map Reporting System. (See "Building a Minefield Database System," *Engineer*, December 1996, page 14.)

The Tutorial

The Army Global Positioning System Tutorial is a training tool developed to provide a nontechnical, operational perspective of the NAVSTAR (navigational, strategic, tactical, and relay) GPS. It is primarily intended for officers and NCOs responsible for planning and executing operations at theater level and below. However, any military personnel wanting to maximize the benefits of GPS for their mission, unit, and troops can use the training.

The tutorial consists of 13 modules designed to be viewed in sequence (see sidebar, page 37). The program incorporates lessons learned as GPS evolved from a developmental program to the operational fielding currently underway in all U.S. military services.

The Army GPS Tutorial shows how the GPS's diverse capabilities can be used to support any mission when you plan and conduct combat operations or operations other than war (OOTW). It delivers convenient GPS training that will increase your unit's mission effectiveness in targeting and navigating precision and accuracy.

The Army GPS Tutorial Modules

Module 1 - GPS Overview. Explains what GPS is, how it works, and what it can do for your unit. It details military applications (such as precise positioning and navigation, communication time synchronization, confident rendezvous, and common language in joint and combined operations) and GPS accuracies.

Module 2 - GPS Policies. Describes DoD and Joint Chiefs of Staff policies and guidance for military operations planners. For example, all services must employ militarily accurate GPS equipment to support their operations.

Module 3 - GPS Security. Describes how military receivers obtain the best accuracies and reduce exposure to electronic warfare (spoofing), cryptologic key loading requirements, and setting up an account for the cryptologic keys. The GPS keys are different than SINCGARS (Single-Channel, Ground-to-Air Radio System) keys.

Module 4 - Maps and GPS. Describes the complementary relationship between GPS and maps. It contains eye-opening lessons learned and important tips (such as *never* use a map for precise positioning or targeting; use the GPS). GPS coordinates are seven times more accurate than map coordinates. Failure to comprehend the new relationship of maps and the GPS can lead to confusion in the field, a lack of confidence in the GPS, and forfeiture of the precision provided by the GPS.

Module 5 - GPS Equipment. Describes current receivers and selected receivers being developed.

Module 6 - Survivability. Discusses threats to the GPS and countermeasures.

Module 7 - Interoperability. Characterizes the GPS contributions to battlefield interoperability and provides guidance on relationships between the GPS, maps, fire-control systems, command and control systems, and navigation sensors.

Module 8 - GPS Applications. Explains the diverse capabilities of GPS receivers and how military operations planners and field users can capitalize on those capabilities during combat operations and OOTW. The module reflects on GPS applications used by U.S. and allied operational forces since the late 1980s, as derived from operational evaluations, Operation Desert Storm, and other military operations. The module describes premission and postmission applications, as well as applications for situational awareness, battlefield preparation, targeting and fire support, close air support, air drop, communications, and navigation. For example, the GPS can function as a compass inside a metal vehicle.

Module 9 - Battlefield Implementation - Operations Planning and Execution. Presents a checklist with suggested actions for commanders and their staffs to carry out on the air/land/sea battlefield. Actions draw on operational experience with the GPS and are oriented toward theater and component staffs with responsibility to plan, execute, and control an operation. Actions can improve target accuracy and reduce the potential for fratricide.

Module 10 - The Future. Presents future applications of the GPS within the U.S. military services.

Module 11 - GPS Training. Lists DoD training support for the GPS. It includes PLGR training, GPS survey receivers, cryptologic key ordering procedures, points of contact, and training aids. The module shows the classroom setup for PLGR training.

Module 12 - Feedback. Provides a form to submit comments and recommendations.

Module 13 - Glossary and Terms. Contains more than 130 GPS-related terms and definitions.

Note: A HELP key describes additional features in the tutorial.

Obtaining the Tutorial

The National Imagery and Mapping Agency (NIMA) (formerly the Defense Mapping Agency), Saint Louis, Missouri, produces and distributes the Army GPS Tutorial.

It is free to military units and can be ordered from NIMA through normal supply channels. Call the NIMA Order Fulfillment Department, DSN 287-2495 or (800) 826-0342, for assistance. When ordering, use your DoD activity address code (DODAAC) and request national stock number (NSN) 7644-01-416-4051. If you do not have a DODAAC, contact the NIMA Army Customer Support Team at DSN 570-3001 or (703) 264-3001.

The tutorial is on eight 3.5-inch discs. Minimum computer system requirements for using the program are—

- DOS Windows 3.x
- 486 PC
- 256 color VGA monitor
- 8 MB RAM

NIMA also has three GPS receiver emulators available. They are computer-based interactive replicas of the PLGR, the Trimble 4000SSE, and the Ashtech MD-XII. These emulators are still in the Beta versions but can provide valuable training. Order them using the same procedure as for the tutorial. The national stock numbers for these emulators are—

- PLGR Emulator 7644-01-416-4034
- Trimble 4000SSE 7644-01-416-4040
- Ashtech MD-XII 7644-01-416-4036

Other Resources

Additional information about the GPS is available on the Internet at the following sites:

- University of Texas at Austin - <http://www.utexas.edu/depts/grg/gcraft/notes/gps/gps.html>
- U.S. Coast Guard - <http://www.navcen.uscg.mil/gps/gps.htm>
- NAVSTAR GPS Internet Connections - <http://gauss.gge.unb.ca/GPS.INTERNET.SERVICES.HTML>
- National Geodetic Survey - http://www.ngs.noaa.gov/geodetic_links.html



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Mr. Forman is the education advisor for the Defense Mapping School, Fort Belvoir, Virginia, as part of the National Imagery and Mapping Agency's National Imagery and Mapping College. He is a reserve Infantry lieutenant colonel assigned to the Army Materiel Command.

Introducing Terrabase II

By Captain Russell Kirby

"Our engineers must be terrain visualization experts so they can help the maneuver commander use the terrain to his advantage to win...The engineer's business is terrain, pure and simple. We own the ground."

*Major General Clair F. Gill
Commandant, U.S. Army Engineer School*

How do engineer officers become terrain visualization experts? One solution from the U.S. Army Engineer School is provided by Terrabase II (TB II) and an instructional CD-ROM. The CD-ROM provides transitional training on the capabilities of TB II and explains how to use digital terrain data to visualize battlespace. TB II and the CD-ROM will be available at no cost to military units in late September 1997. They will enable all officers, not just engineers, to understand, use, and obtain digital topographic products.

The following information provides a brief overview of the TB II software and CD-ROM. Basic knowledge of the TB II software is a first step toward visualizing terrain, but the applied tactical knowledge of the user is what really makes this software powerful.

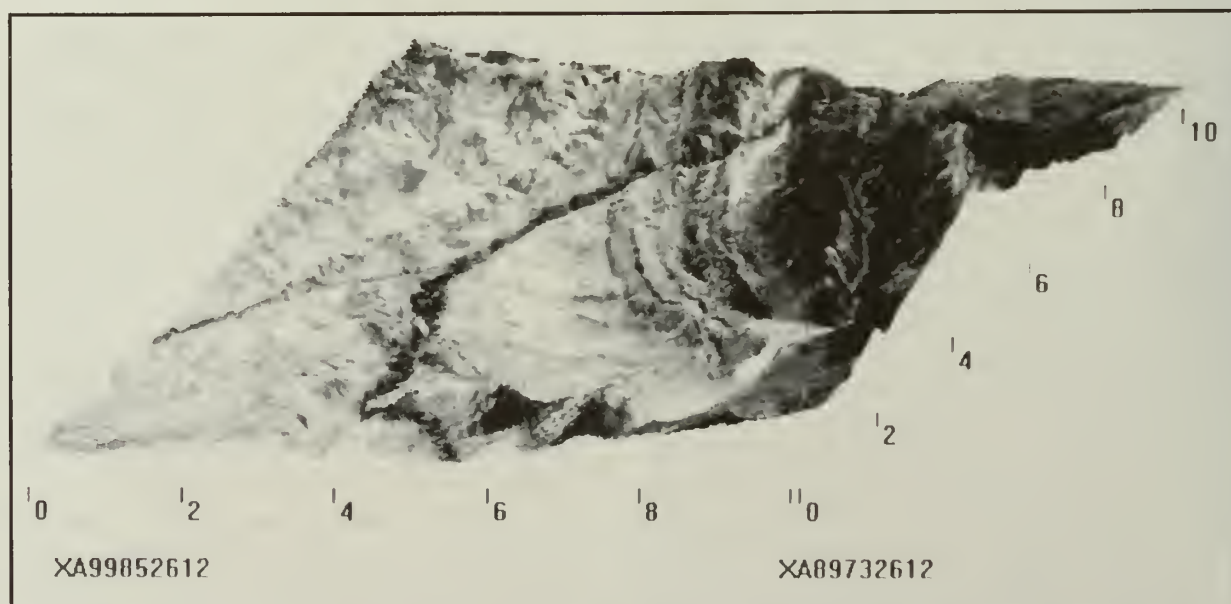
Background

The Terrabase program was written at the U.S. Military Academy in the mid-1980s and was the first automated terrain tool used by military occupational specialty (MOS) 215D topographic warrant officers and MOS 81Q terrain analysts. It allows the user to quickly analyze terrain data and provide warfighting commanders with tactical decision aids (TDAs).

Terrabase runs on IBM 286 computers, and its output is limited to dot matrix printers. The software has changed little since its development. Although it is still widely used at the brigade level and below, Terrabase does not take advantage of automation advances and many improved digital data sets.

Terrabase II

The Engineer School's Department of Tactics, Leadership, and Engineering, in partnership with the Terrain Visualization Center, researched available commercial and government-owned programs to find an updated terrain evaluation tool. None was found, but a government-owned terrain evaluation software package



Digital elevation model (DEM) data with SPOT satellite image draped over it. This image shows an area at Irish Canyon, Colorado.

called MicroDEM, developed by the U.S. Naval Academy, was suitable for tailoring into terrain visualization software. This powerful personal-computer-based package operates under Microsoft Windows and uses a variety of improved digital terrain data available from the National Imagery and Mapping Agency and the U.S. Geological Survey.

MicroDEM was demonstrated to senior leaders and approved for adaptation by Major General Gill on 16 December 1996. The Terrain Visualization Center at the Engineer School arranged for training development funds. Both the 20th Engineer Brigade at Fort Bragg, North Carolina, and the U.S. Space Command at Colorado Springs, Colorado, contributed funding to tailor MicroDEM into Terrabase II. The Naval Academy and the Engineer School worked together to develop the software.

The minimum requirement to run Terrabase II is a 486 computer with 16 MB of RAM and Windows 95. The program creates all the tactical decision aids of the original Terrabase. In addition, Terrabase II can—

- Change datums.
- Make elevation tints, slope tints, contour plots, lines of sight, 3-D views, reflectance maps, weapons fans, and visible area plots.
- Print to scale on any Windows-compatible printer or plotter.

The beauty of this software is that anyone familiar with Microsoft Windows can learn to use it quickly. Terrabase II will be included in the Engineer Officer Advanced Course beginning in July 1997. It can be taught in the same amount of time as the original Terrabase.

CD-ROM

The instructional CD-ROM can be used for distributive training for individuals or groups, such as for officer professional development or commanders' calls. The CD-ROM includes the following segments:

"Introduction to Terrain Visualization" provides an overview of terrain visualization. It includes map fundamentals, datums, grids, symbology, and accuracy.

"Request and Manage Terrain Visualization Data" provides examples and explanations of digital data products from the National Imagery Mapping Agency and U.S. Geological Survey. The examples are explained in bullet comments with an accompanying voice file to provide details. This segment describes the tactical use of each product as well as ordering information and price. This is the first time that a simple-to-use viewer has been available for digital formats from both mapping agencies. TB II makes it possible to import these formats.

Terrabase II Tutorial is a "battledrill" or "how to" version for creating tactical decision aids. These interactive/multimedia battledrills have pictures that show how the

"Terrain visualization is a basic and fundamental leadership skill. ... A battle commander must understand how terrain influences every aspect of military operations. Terrain visualization is a component of battlefield visualization. It portrays and allows a detailed understanding of the background upon which enemy and friendly forces and actions are displayed."

TRADOC Pamphlet 525-41, *Topographic Support for Terrain Visualization, Operations Concept*

screen looks as the products are created. The tutorial is an easy-to-use aid that explains how to load the software and digital data, create TDAs, and save and print products.

Database includes data sets for each area of operation for the Engineer Officer Advanced Course practical exercises. A data set includes digital terrain elevation data (DTED), land satellite (LANDSAT) or Systeme Probatoire d'Observation de la Terre (SPOT) satellite imagery, controlled image-based imagery, and aerial photographs. Since all areas of the world do not have complete data, some of the sets are not complete.

Product Index is a list of digital products with "hot keys" that enable the user to choose to "view the product example" or "learn more about the product."

Conclusion

Terrabase II fills the terrain visualization requirement for engineers at the brigade level and below. The instructional CD-ROM educates engineers on how products look, their availability and tactical use, and how to obtain digital data. TB II software is not designed to compete with more advanced terrain analysis systems. Instead, it introduces some of the capabilities of larger systems and enables users to better understand these products.

The increased knowledge and computer capability officers gain from using Terrabase II will give them greater planning flexibility by providing a wide range of options for each mission. The TB II software and instructional CD-ROM enable engineers to become terrain visualization experts and truly earn the title "Masters of Terrain."

Note: TB II will be available on the Fort Leonard Wood home page by late September. The CD-ROM will be reformatted and added to the home page by December 1997.



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Command Philosophy for Company Commanders

By Lieutenant Colonel Harry W. Christiansen (Retired)

Have you ever been in a unit where soldiers were unsure of the new company commander's expectations and his method of operation? The result is trial and error, second-guessing, and misdirected work efforts. In short, the unit spends most of its energy discovering the commander's intent, which detracts from effective mission accomplishment.

The solution is a well-developed and communicated command philosophy. If you are preparing for your first command, take time to develop a command philosophy. This philosophy tells how you will run the unit. It communicates your expectations of others and what they can expect from you. It sets the conditions that allow subordinate leaders and teams to succeed. A command philosophy has four components—vision, values, leadership expectations and personal convictions. As a company commander, I used the command philosophy shown on page 41 and distributed it in a memo to officers, NCOs and soldiers in my company.

Vision

Vision provides a common focus for the unit's energy and sets priorities. It describes what the unit must be capable of doing at some point in the future and how to achieve that. To help develop your vision, educate yourself about the unit. Visit and talk with key members of the battalion and company.

First, meet separately with the battalion commander and command sergeant major. Learn their priorities and expectations for the unit, and get a copy of the battalion commander's philosophy. Spend time with the outgoing commander and the unit first sergeant. Ask

about major issues and problem areas and the unit's strengths and weaknesses.

Other key individuals who can help are the battalion executive officer, the operations officer, and fellow company commanders. Finally, talk to the platoon leaders, platoon sergeants, and soldiers. As the recipients of your command philosophy, they are the ones who will get the job done.

Once you sift through and evaluate this information, you will have more than enough ideas on where the unit needs to go and what the soldiers think should be done. A shared vision, one that soldiers own and can relate to, will permeate the unit and influence all its endeavors.

In the figure, vision sets the direction. It tells soldiers where the unit is going and how it will get there. The vision is a journey, not a destination; it is something you are always striving to achieve.

Values

It is impossible to create a rule or policy to cover every possible contingency. However, members in a unit who share the same values will view the world and their work from a common perspective and act accordingly. Values express what is important to you and subsequently to the unit. They outline expectations of unit members and express what "we will do."

You have a professional obligation to live and uphold the Army's values and ethos as well as the soldier qualities outlined in FM 100-1, *The Army*. That FM is a good place to start developing your value set. To identify your values, follow the three-step process:

- List the characteristics, traits, and qualities you admire in leaders.

- Circle the qualities that reflect what is important to you and that reveal the kind of leader you are.

- Define those qualities as behaviors that you will demonstrate.

The values on page 41 are tools that tell soldiers what is important to the unit, and they guide everyday behavior. Your values must represent who and what you are. They must come from the heart.

Leadership Expectations

Leadership expectations describe specific responsibilities and fundamental obligations leaders have to their soldiers. This is your foundation for leadership action. Leadership expectations describe the leader's role in developing combat-ready soldiers and teams.

Think about the few critical principles that you feel are imperative for leaders to succeed. These essential rules are the cornerstones for your leadership philosophy. If you need some ideas, the 11 principles of leadership in FM 22-100, *Military Leadership*, are fundamental truths that have stood the test of time. Leadership expectations can be a series of phrases, statements, or a narrative.

The leadership expectations on page 41 outline obligations leaders have to their soldiers. Whatever you decide are your leadership principles, they should reflect how you lead and how you expect subordinate leaders to lead.

Personal Convictions

Personal convictions tell soldiers how you do business, answer frequent questions, and give

Command Philosophy

PURPOSE: To ensure that you know my expectations of soldiers and leaders in this company. This memorandum outlines my command philosophy.

VISION: The XXX Company has one purpose: We are a combat-ready force prepared to successfully execute our wartime mission while maximizing soldier survival. We will accomplish this by tough, realistic training focused on our mission-essential tasks.

VALUES: Even if you do not know exactly how to do something, if you know what is important to the company, you will do the right thing. The following values, or things that are important, will guide our daily actions:

- **Integrity.** We will be truthful and honest in all dealings with others. We will be responsible for taking action to do the right thing and ensure success.
- **Commitment.** We will approach our work through personal commitments that must be filled in spirit. We will focus our hearts and energy into successfully getting the job done right.
- **Caring.** We will help each other and take care of our own. We will concern ourselves with human needs and treat others with fairness and dignity.

LEADERSHIP EXPECTATIONS: Lead by example in everything we do and never forget that soldiers are the most important part of this company. Four obligations leaders have to soldiers are:

- **Educate.** Orient new soldiers to the company goals and values, and teach soldiers who want to grow.
- **Coach.** Empower soldiers to contribute to the company and build on the strengths of talented performers.
- **Counsel.** Lead soldiers to understand and overcome obstacles that get in the way of top performance.
- **Confront.** Tell soldiers when their performance is consistently below expectations and bring to their attention the consequences of continued unacceptable performance.

PERSONAL CONVICTIONS: These key points will help you understand how I do business:

- We are in this together—we are a team.
- Be sure that what you tell me is correct.
- Keep me informed—bad news does not get better with time.
- Good tries that fail are okay—only through risk is there growth.
- Where you spend your time shows what is important to you.
- I use the chain of command—NCOs are the vital link.
- Performance counseling ensures your expectations of others are clear—do it.
- OERs and NCOERs—officers and NCOs are paid to lead.
- Power down—If you can handle it, I will give you the controls.

soldiers a starting point. They can be your *dos* and *don'ts* or a mix of diverse topics. Personal convictions may include bits of wisdom or quotes you have retained over the years that reflect how you operate. They are key points to help soldiers understand you and your frame of reference or “where you are coming from.” You can express personal convictions as a series of bullet-type statements or one-liners.

The personal convictions in the figure provide soldiers further insight on what they can expect from their commander. This component of your command philosophy covers topics important to you that are not covered elsewhere.

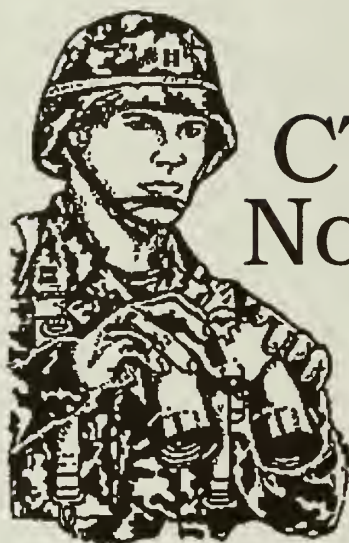
Walk Your Talk

A command philosophy has no specific format. It can be a one- or two-page memorandum, a series of bullets, or a graphic. Every soldier should receive a copy and should easily comprehend the philosophy.

A well-developed command philosophy allows you to concentrate the unit's energy by creating a shared perception of what the company is all about and how you will run it. *Vision* describes the company's future capability. *Values* outline what is important to the company. *Leadership expectations* are the foundation for leadership action. *Personal convictions* tell how you do business. Once you publish your command philosophy, soldiers will watch to see if your behavior matches your words—you must walk your talk.



Lieutenant Colonel Harry Christiansen (Retired) is a Strategic Change Management Consultant with Group Decision Support Systems, Inc., Washington, D.C. He commanded three company-level units and was a leadership instructor at the Infantry School. He holds a master's degree in organizational development.



CTC Notes



Battle Command Training Program (BCTP)

By Lieutenant Colonel Dave Snodgrass

The good news these days is that almost everyone at corps level and below is familiar with obstacle-control measures. The bad news is that confusion remains about when and how to use the measures and intents, and specifically, whether corps and divisions must have zones and where they must include intents with zones. The larger, more generic, question is when and how engineers should use zones.

Doctrinal answers to the specific questions are: No, you do not have to use zones, and no, you do not have to include intents. According to FM 90-7, *Combined Arms Obstacle Integration*, commanders use obstacle-control measures to simplify granting obstacle-emplacement authority and provide obstacle control. The overriding principle in our current top-down, permissive system is to "...ensure that subordinates emplace obstacles that support the higher commander's scheme of maneuver and that do not interfere with future operations." Obviously, if the higher headquarters does not want to grant that authority, they do not have to

designate graphics. Further, FM 90-7 states that "...if the obstacle zone encompasses the entire brigade sector, another graphic is unnecessary. Commanders may designate the entire sector as an obstacle zone, with the unit boundaries defining the geographical limits of the zone." Additionally, FM 90-7 states that "...commanders can assign an obstacle intent to an obstacle zone, but they normally do not." Theoretically, established priorities help identify the obstacle main effort to subordinates without restricting their flexibility with specified zone intents.

The answer to the generic question of when and how we should use zones is more complex. Many engineer planners at division and corps levels feel they need to establish zones to focus subordinate efforts, estimate resources required, and show their commanders and staffs that they have integrated engineers into the plan. Unfortunately, these zones usually are large boxes that cover entire sectors, lack intents, and do little to focus anyone or integrate anything. To understand the disconnects, one must reduce the scale and return to the basics. As an observer/controller at the National Training Center, I saw the following methodology of engagement area design and construction validated through numerous rotations and units:

- Identify where the enemy is coming from and where it is going.
- Identify where you want to kill the enemy (or the desired effect).
- Identify the location of the shooter.
- Allocate the resources required to do the killing.
- Identify the location, orientation, and type of obstacles that will best enhance the effects of your killing systems and achieve the overall desired effect.

Units that used this methodology ensured they had a coherent defense with concurrently integrated obstacles that supported the maneuver plan, positions, and systems. Units that failed to use this methodology ultimately wound up with disjointed obstacles that had little or no impact on the battle or, worse yet, ineffective defenses developed around obstacles constructed independently (and sometimes before completion) of the maneuver plan.

In theory, planning at division and corps levels should be very similar:

- Identify where the enemy is coming from and where it is going.
- Identify when and where you want to mass your effects to do the most damage.
- Identify missions and required resources for subordinate units.

- Identify the location, orientation, and type of obstacle effects to best enhance your assigned weapons systems and the overall impact on the enemy.

Yet, division and corps planners almost always allocate sectors for their subordinates. They seldom provide directions on when, where, and how to mass unit resources and effects on the enemy. The lack of direction has critical results. When the division and corps fail to develop a fight based on a clearly defined concept that identifies subordinate unit purposes and how those purposes interrelate to accomplish the division's overall task and purpose, they tend to fight battles in pieces instead of in a coherent, complementary, and focused whole. The lack of vertical and horizontal nesting degrades a unit's ability to bring all weapons systems to bear on the enemy at a decisive point and time. If one subscribes to the engagement area design and construction methodology, how can the engineer planner design an obstacle plan that enhances the defensive plan if the division or corps commanders have not clearly defined the purposes of subordinate units and how they are integrated to focus power?

The engineer planner's first responsibility is to identify the disconnect to maneuver commanders and staffs and seek a clear, articulate, *maneuver* vision of the battle, stated in maneuver terms, that will convey to subordinate commanders how each subordinate piece supports the whole. When this information is provided, the engineer planner can and should develop obstacle-control measures that support the operation. If we know *who* and *where* the unit plans to fight, we should be able to design a relatively small, targeted, and useful zone to support the fight. We also should be able to assign it an intent that supports higher maneuver commander's concept of the fight. This is critical when planning and preparation time are restricted. When a unit has limited time to establish a defense, the higher headquarters should be more prescriptive with the maneuver and engineer plans in order to focus the engineer effort—and not designate entire sectors as obstacle zones. This action will restrict the flexibility of subordinate commanders. But it will also eliminate options that take time to evaluate, focus the resources of both higher and lower headquarters, and allow the unit to spend the maximum time available in executing the obstacle plan.

Alternatively, if the corps or division fails to develop a clear, focused plan of defense that designates the killing ground and how subordinate units complement each other, the best option may be to designate the entire sector as an obstacle zone, with unit boundaries defining the geographical limits of the zone. In this case, tell subordinate units that they are defending in sector and that their sector is an approved zone. Instead of creating redundant and essentially useless permissive control measures, focus on

restrictions that the higher headquarters require to maintain obstacle control and that support future operations. Restrictions may include obstacle-restricted areas for counterattack avenues, reserve demolition targets that support specific tactical operations, types or duration (for FASCAM) of obstacles in specific areas or on specified routes, etc. Let subordinate units develop their own obstacle-control measures based on the specified restrictions. Then, if required, draw zones around the subordinate units' graphics to conform to the doctrinal obstacle numbering system and unit tracking and reporting procedures. Allocate initial resources for planning based on sector priorities, the usable widths of the avenues of approach across the sector, and a disrupt planning factor. This procedure gets the logistics system energized and materials moving, gives subordinate units a number to start planning with, supports the initial (24-hour plus) requirements, and allows for future refinements.

We engineers have achieved success in our initial battle to familiarize maneuver commanders and get all units using obstacle control graphics and intents. The harder battle now facing us is to refine how and when we should use, and more importantly should not use, these new-found tools. When used properly, these tools minimize the unnecessary restrictions that we place on subordinate units and help streamline the planning and preparation of successful battles.

Lieutenant Colonel Snodgrass is the staff engineer for the multinational force in the Sinai Peninsula. He previously served as the engineer observer/controller for the Battle Command Training Program at Fort Leavenworth, Kansas.



Joint Readiness Training Center (JRTC)

By Captain John C. DeJarnette

Effective FM radio communications are essential to properly synchronize engineer operations in support of maneuver units. Two emerging techniques using SINGARS effectively improve engineer command and control. The first involves engineer platoon FM communications, and the second is the engineer "conference call" daily update.

Engineer Platoon FM Communications

At the JRTC, engineer platoons are routinely required to operate continuously on three FM radio nets: the platoon internal net, the supported maneuver commander's net, and the parent engineer unit command net. These are minimum requirements for commanders to control and synchronize the efforts of their supporting engineer units.

Successful engineer platoons employ the following communications technique or a variant of it:

- Engineer squads operate on the engineer platoon net. This technique allows the engineer platoon leader to control the platoon members' work and also provide regular updates on the tactical situation within the battalion area of operations.
- The engineer platoon sergeant deploys with a dual-net-capable vehicle. He operates on both the engineer platoon net and the engineer company command net. Dual-net capability allows him to remain current on the status of the platoon's mission and respond to routine traffic from the engineer company command post. When the platoon leader is needed on the engineer company command net, the platoon sergeant calls him on the platoon internal net and directs him to the engineer company command net. While engineer platoon sergeants currently are authorized only single-net capability, most find an additional radio to deploy with, mirroring the authorization in tank and mechanized infantry tables of organization and equipment. Dual-net capability for the engineer platoon sergeant greatly improves command and control at both the engineer platoon and company levels.
- The engineer platoon leader uses his authorized two-net capability to monitor both the engineer platoon internal net and the supported maneuver unit command net. This capability allows him to control the engineer platoon and be responsive to the maneuver commander. A key benefit of monitoring the maneuver command net is improved situation awareness. Dual-net capability enables the platoon leader to track the actions of the maneuver companies and their enemy contacts. Consequently, he can provide timely and accurate tactical updates to his squad leader and provide guidance to the maneuver battalion command and tactical operations center. This technique allows the engineer platoon leader to better perform his dual role as platoon leader and task force engineer.

Engineer Company "Conference Call" Update

Successful engineer company commanders use two daily conference calls on their command net as a synchronization

tool. The calls generally are scheduled during lulls in the rotational brigade's battle rhythm, typically about 0600 and 2000 hours. The net control station initiates a call for all platoon leaders, the brigade engineer, the executive officer, the first sergeant, the supply sergeant, and the maintenance team chief. Each section updates the commander with changes regarding their combat power (personnel, key leaders, critical equipment), supply status (Class I, III [package], V, IX), operations during the last 12 hours and anticipated operations during the next 12 hours. Each session usually takes from 3 to 5 minutes. The brigade engineer provides an overview of the friendly and enemy situation across the brigade and any anticipated mobility and survivability requirements. The company commander then provides planning and execution guidance to the platoons.

This update improves the situation awareness of the commander, platoon leaders, brigade main engineer cell, and brigade rear engineer cell. It also serves as a basis for revising the engineer estimate for future operations planning. In the most proficient units, squad leaders monitor the daily updates in order to clearly understand the commander's intent and gain information on enemy and friendly activities across the brigade area of operations.

The conference call, coupled with the engineer platoon sergeant as a control node, are excellent tools to synchronize engineer operations.

Administrative Notes

- LTC Brooks will remain the senior engineer observer/controller at the JRTC for the next year
- JRTC has finalized the Exercise Rules of Engagement for Air VOLCANO employment. The VOLCANO control supply rate remains at 720 canisters (two loads) per rotation, regardless of the delivery platform. Exceptions to this control supply rate are managed by the commander, 21st Infantry Division, with input from the assistant division engineer. Units are encouraged to deploy with their M87 training canisters in order to fully exercise their VOLCANO loading battle drills.
- Continue to send us questions and recommendations about mobility and survivability operations and techniques. The commercial telephone number is (318) 531-0266/0282 (DSN 673-0266/0282). The e-mail address is: brooksje@polk-emh2.army.mil.

Captain DeJarnette is an engineer observer/controller at the Joint Readiness Training Center, Fort Polk, Louisiana.



National Training Center (NTC)

By Captain Ed Mead

The NTC provides an excellent opportunity for combat engineer company commanders to plan and execute company-level combat engineer missions. For some company commanders, the NTC is their only opportunity to get intense company-level training with the brigade combat team they support. This article describes some recurring trends observed at the company level from units rotating through the NTC. Although some trends change from quarter to quarter, the following trends were observed frequently during the past two years.

Combat engineer companies are not proficient in how to maneuver and employ weapons systems as a unit or as part of a larger maneuver element.

Discussion

- Even though possessing a significant amount of fire power, units have no fire-control measures for M2s, MK19s, AT4s, or attached M1A1 tank plows or rollers.
- Units do not understand mounted or dismounted movement formations at company and platoon levels.
- Units fail to plan for actions on contact.
- Units are unable to effectively integrate into combined arms breaching operations. Engineers are especially weak at commanding the breach force when called upon to do so.

Recommendations

Combat engineer leaders must incorporate the strategies described in FM 5-71-2, Appendix E, and FM 71-123, Chapters 3 and 4, in their leadership development training. Additionally, they should incorporate force protection training in every training event. Leaders should ensure that some company collective maneuver training is planned and executed each quarter.

Knowledge of FM 90-7, Combined Arms Obstacle Integration, is weak. As a result, units fail to effectively integrate obstacles with fires.

Discussion

- Units do not understand mobility corridors and avenues of approach or their fundamental relationships to the target, location, and effects of tactical obstacles.
- Task forces do not develop a conceptual obstacle design for company team commanders and engineer platoon leaders to help them visualize the obstacle layout within the group or the quantity of resources required.
- Task forces seldom produce a modified combined obstacle overlay (MCOO). This product is essential to help visualize enemy avenues of approach.
- When siting obstacles, units do not understand how to integrate obstacles and fires to achieve the desired effects.

Recommendation

Engineer commanders should conduct officer professional development classes on obstacle planning and siting for their habitually associated maneuver units. Each combined arms exercise (command post exercise, map exercise, terrain exercise without troops, etc.) should include a rock drill that focuses on siting obstacles. Company team commanders and engineer platoon leaders should be key players in these rock drills.

Combat service support and maintenance operations at the engineer company level continue to need improvement. Units do not always report classes of supply to the company tactical operations center.

- Company LOGPACS brought forward from the brigade support area are configured to provide only Classes I and III, not all classes of supplies and services required by line platoons.
- Inadequate time management for maintenance shutdowns during continuous operations often cause a steady decrease in operational readiness rates.
- There is a lack of discipline in subsystems preventive maintenance checks and services for night vision devices, machine guns, individual weapons, and communications equipment.

Recommendation

The engineer company first sergeant must be involved in developing and briefing paragraph 5 of the operation order. Company commanders and platoon leaders must ensure they plan for and conduct precombat inspections, including combat service support and maintenance checks. Commanders must plan for and incorporate combat service support training in every training event.

Captain Mead is an engineer observer/controller at the National Training Center, Fort Irwin, California.

The Engineer Reconnaissance Platoon: Overcoming the Lack of Engineer Reconnaissance Assets

This is the second in a series of articles about the roles of NCOs in an engineer battalion of a heavy division. The first appeared in December 1995. This article builds on ideas proposed by Major Douglas McNeese and Captain Steven Creighton (*Engineer*, August 1996, p. 14) and provides further clarification.

By Michael W. Sayer

It was two hours prior to LD (line of departure) for the armored brigade's deliberate attack. The commander arrived for the prebattle update, and each staff member briefed him on the status of his area. The scouts had located and reported some obstacles in the area but had not specified their orientation, composition, length, depth, or type before losing contact with the brigade. The staff engineer could not give more information, because communications with the engineers sent to gather engineer-specific obstacle intelligence failed early in the evening. The enemy identified additional engineers, who left at 2400 hours in their M113 Armored Personnel Carrier, and engaged them with direct and indirect fires. Due to the lack of information concerning enemy obstacles and disposition of his forces, the brigade commander had to inform the division that his unit was unable to conduct a deliberate attack but would conduct a movement to contact. He was not confident of the brigade's ability to fully accomplish the mission. The lack of battlefield intelligence, primarily the lack of mobility and counter-mobility information, degraded the brigade's capability to fight and win.

The Problem

Variations of this scenario occur during training at the National Training Center (NTC) with disturbing regularity. Scouts often fail to provide leaders with specific mobility/survivability Battlefield Operating System information. Brigades require solid obstacle intelligence to successfully attack.

In maneuver battalions—

- Scout platoons lack experience with mobility/survivability tasks and the data required for complete reporting.
- Scouts have too many tasks specified in the operations order.
- Mobility/survivability tasks generally receive too little emphasis during unit training.

In engineer battalions—

- A scout capability is lacking on the modified table of organization and equipment (MTOE).

- Soldiers tasked with gathering obstacle intelligence usually lack scouting experience.
- Training and equipping engineers tasked with reconnaissance is not standardized.
- Communications capability within the force is poor.

The Solution

These are serious problems, but a solution is within reach that is both simple and difficult: Place an engineer scout platoon within the divisional engineer battalion. The solution is simple in that assigning personnel to such a platoon and equipping it can be accomplished quickly. The difficulty lies in finding the bodies in a shrunken force structure to support it and then training these soldiers to accomplish their mission.

Most combat engineer companies pick a team to perform as engineer scouts. The team's training is usually haphazard and is not conducted in conjunction with the brigade S2 section's training of other scouts in the brigade. While the team members probably are highly motivated young soldiers and well-trained engineers, the lack of formal training in reconnaissance operations lessens their overall capability.

Only one position in the current heavy engineer battalion MTOE has anything to do with reconnaissance—the reconnaissance noncommissioned officer (NCO). This position requires a military occupational specialty (MOS) 12B30, combat engineer staff sergeant. He receives no special training and often lacks reconnaissance experience and the equipment necessary to perform this duty. Frequently, he is part of the battalion intelligence section and works for the intelligence NCO, MOS 12Z50, who is a combat engineer master sergeant. As currently structured, any reconnaissance effort on the part of the heavy engineer battalion comes from the line companies. They must give up squads for this mission, which means that those squads are unavailable for other offensive and defensive missions.

One active heavy engineer battalion is working to incorporate a dedicated reconnaissance section—the 299th Engineer Battalion, from the 1st Brigade, 4th Infantry Division. As part of the Advanced Warfighting Experiment, the 299th is seeking ways to add new technologies to the tactics needed for Force XXI. The unit has organized a reconnaissance section of two teams under

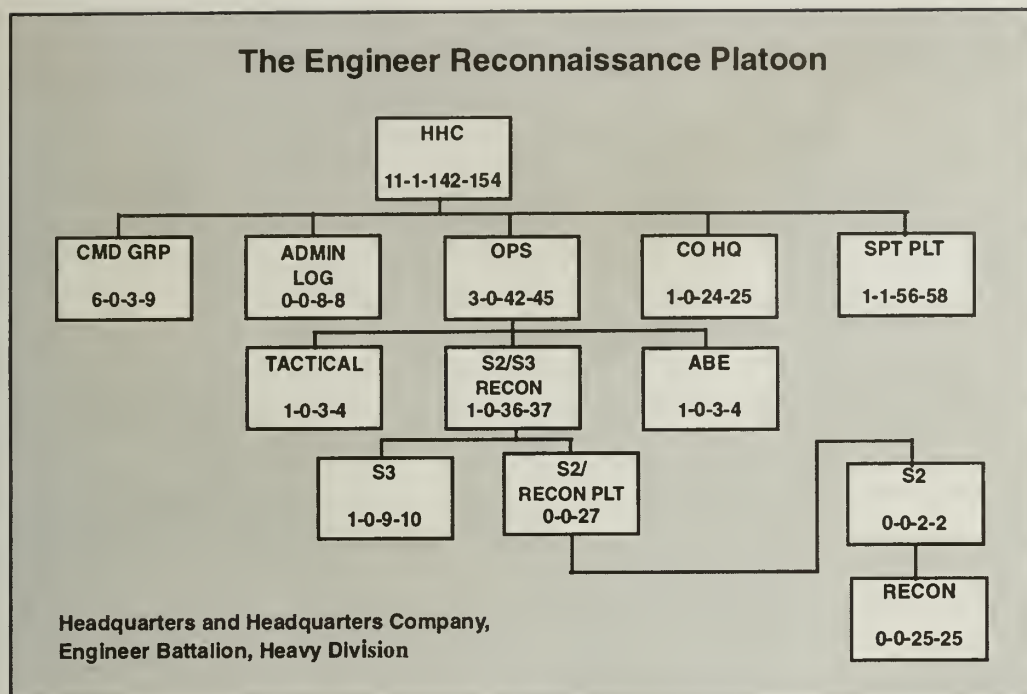


Figure 1

battalion control. While this is a good starting place, it cannot cover the entire brigade sector. With two teams attempting to gather information from three task force zones, the effort is too little and the information probably will be received too late.

Reconnaissance Platoon

A recommended solution is for the engineer force to assign and equip an engineer reconnaissance platoon within the Headquarters Company S2/S3 section. The platoon would work for the S2 under the reconnaissance NCO (Figure 1).

Organization and Equipment. By placing the unit in the S2/S3 section of the heavy engineer battalion, command and control of the platoon is at the proper level. The S3 ensures that the unit has adequate resources for training, and since the platoon is organic, the S3 knows the capabilities and limitations of each squad when he conducts the planning and orders process. Additionally, each squad can be broken down to the habitually associated task force in a direct-support role when the mission dictates. In this configuration, the brigade order must specify that the task force and engineer company pass the proposed tasking of the squad to the engineer battalion for required support. The squad would seldom, if ever, be attached to or placed under operational control (OPCON) of the task force.

The purpose of having the intelligence NCO in the chain of command is to ensure proper training and required coordination with the brigade and task force S2s. The intelligence NCO is the platoon leader and assists the reconnaissance NCO in developing training schedules, gathering materials,

and ensuring that all training meets applicable standards. Each squad associates with a specific task force to increase interoperability and build teamwork. The intelligence NCO, in conjunction with the reconnaissance NCO, is the liaison to each task force for training and determines personnel allocations within the platoon.

The engineer reconnaissance platoon is a 25-person unit that includes the reconnaissance NCO as platoon sergeant and three squads of eight engineer scouts. Two four-person teams make up each squad, with the squad leader acting as the A Team leader and an engineer sergeant acting as the B Team leader. The senior enlisted soldier is the gunner, and of the two junior enlisted soldiers, one is the engineer scout and the other is the driver. The reconnaissance NCO position changes from that of a staff sergeant to a sergeant first class, with the position coded for ranger-qualified NCOs. The squad and team leaders and the gunners also should be ranger qualified (Figure 2, page 49). Each team operates in an M1044 HMMWV. This organization provides one engineer scout squad to each task force in the brigade, with each scout squad capable of working as two teams covering the task-force zone. If the situation requires, as for a dismounted approach, each team can break into two two-person foot-reconnaissance teams. This configuration allows greater saturation of the area and long-term (more than 8 hours) observation of objectives. Possible applications include:

- Inserting the team into the task force zone early to observe and report enemy defensive preparations.
- Positioning the team to report enemy movement to bring forward engineer-specific breaching or river-crossing equipment.

Engineer Reconnaissance Squad Equipment

<i>Equipment</i>	<i>Quantity</i>	<i>Remarks</i>
High-mobility, multipurpose wheeled vehicle (HMMWV), M1044	2	Supplemental armor provides crew protection from small-arms fire and artillery fragments.
Mounted on HMMWV		
Machine gun, .50-caliber, M2 or Grenade launcher, 40-millimeter, MK19	1	One vehicle has the M2, the other the MK19; allows both long-range and short-range indirect fires.
Short-range/long-range vehicular radio with dismount, AN/VRC-91A	1	Allows squads or teams to report from most locations within the brigade sector. Teams can conduct two-way operations, one using the dismount system from the AN/VRC-91A, the other the AN/PRC-119A.
Antenna, OE-254	1	
Loudspeaker, LS-671	1	
Intercom set, AN/VIC-1	1	Allows communication within the vehicle.
Combat vehicle crewman helmet	4	
Telephone, TA-1	1	
Control monitor, C-11291	2	
Precision lightweight global positioning system (GPS) receiver, AN/PSS-11	1	
Pneumatic boat, 3-person	1	For bridge and stream reconnaissance.
Camouflage screen and support system	1	
Mine detector, AN/PSS-12	1	For breaching or route reconnaissance.
Reeling machine with communications wire, RL-39	1	Supports outposts/listening posts.
Two-Person Team		
Individual weapon and ammunition	2	Either the M16 or M16/M203.
Night vision goggles, AN/PVS-7B	2	Support all night operations.
Manpack radio, AN/VRC-119A, or dismounted short-range radio, AN/VRC-91A	2	
Antenna, OE-254	1	
Telephone, TA-1	2	
Precision lightweight GPS receiver, AN/PSS-11	1	Supports split-team operations.
Compass, lensatic	2	Supports all operations.
Binoculars	2	Determines target position.
Sniper scope with laser	1	Determines target position.
Demolition kit	1	For breaching or route reconnaissance.
Clinometer	1	Measures elevation.
NBC equipment	2	

NOTE: Team equipment load (minus personal load-bearing equipment [LBE] and spare clothing) is about 120 pounds.

The Engineer Reconnaissance Platoon Organization and Manning Structure

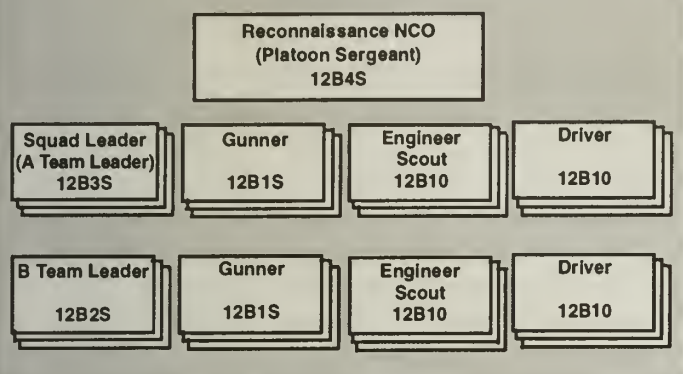


Figure 2

- Using the team as "deep eyes" for detailed engineer technical reconnaissance.

Equipment for the engineer reconnaissance squad is shown on page 48.

Training the Force. Placing the platoon under the S3 pays high dividends for training. During quarterly training briefs and regular training meetings with the brigade and task forces, the S3 verifies that engineer scouts are part of training events, particularly for lane training. Attending these events strengthens their habitual association and improves the level of training for all concerned. Joint training with the task force scouts reinforces standard techniques and procedures, improves reporting formats, and develops and formalizes policies within the tactical SOPs.

The engineer reconnaissance platoon can help train scout platoons within the brigade on the many engineer-related tasks included in their mission training plan task list. They can also help when scout platoons are scheduled to attend the Sapper Leader's Course. Because the prime emphasis of this course is on demolition skills and introductory patroling techniques, this training will benefit the entire unit.

To be effective, a scout must train in small-unit tactics and techniques. Therefore, the MOS codes for senior platoon members (platoon sergeants, squad leaders, team leaders, and gunners) indicate that their positions should include ranger qualification. Normally this does not occur within heavy forces, but the requirements for dismounted obstacle reconnaissance and deliberate engineer reconnaissance obligate commanders to ensure that soldiers are as well prepared as possible. While this requirement uses scarce training dollars, the skills acquired will pay great dividends during operational deployments.

Manning Issues and Utilization. The S3 should carefully screen soldiers to ensure that only those best qualified are assigned to the scout platoon. Due to the difficulty of the mission, volunteers are the best choice. Random assignment to fill slots is a last resort.

Platoon sergeants are key to developing platoons. When selecting the platoon sergeant, the S3 places him on the battalion staff, where he has the primary mission of reconnaissance. When the reconnaissance NCO selects soldiers to fill the platoon, he selects soldiers for reconnaissance missions, not for staff support. If the reconnaissance NCO is at the brigade tactical operating center, he can help the brigade S2s develop the reconnaissance and surveillance plan. Together with the engineer battalion S3, he develops a solid plan to cover the named areas of interest important to confirming or denying the templated enemy mobility/survivability information. By upgrading the duty position's grade from staff sergeant to sergeant first class, a more mature, experienced leader will be available to assist with all related operations.

When operating tactically, the engineer reconnaissance platoon is the logical choice for covering all mobility/survivability named areas of interest. While not limited to these areas, the reconnaissance platoon is the best qualified to report required information on them. These areas include obstacles on the battlefield as well as any deliberate engineer reconnaissance required within the brigade zone. Ideally, engineer scouts are a brigade asset, much like the combat observation lazing teams.

Scouts efforts are wasted unless the information they find is reported to all echelons. The operations order must specify which reporting nets the teams use and to whom they report. If the scouts are task organized under the task forces, reports must be passed to the engineer battalion to ensure that an accurate, brigade-wide picture of mobility/survivability data develops. The best choice for reporting intelligence is the operations and intelligence net, either at the brigade or task-force level. Teams normally do not report over the engineer battalion nets unless that is specified in the order. An exception is when teams operate solely in support of the engineer battalion; then they report either over the battalion command frequency or the company frequency.

Summary

By establishing and using a dedicated engineer scout platoon, the engineer battalion and heavy maneuver brigade gain a tremendous tool for gathering information. The flexibility, adaptability, and skills of the platoon provide a combat multiplier of the first order. The effects of these teams in the brigade reconnaissance fight are quantifiable and their benefits immediately apparent. While finding personnel to staff the platoon may be difficult, the benefits tremendously outweigh this difficulty. Only by getting these reconnaissance platoons up and running in every battalion can engineers overcome the shortage in reconnaissance expertise and set the conditions for successful battalion and brigade operations.

Mr. Sayer is a military analyst employed by Cubic Applications, Inc., which supports the Sidewinder Engineer Battalion Trainers, Operations Group, National Training Center, Fort Irwin, California.

Book Review



Hall, Gwendolyn Midlo, ed. *Love, War, and the 96th Engineers (Colored)*. Urbana, IL: University of Illinois Press, 1995, 319 pages.

By Dr. Larry D. Roberts, Command Historian, U.S. Army Engineer Center

In late September 1941, Second Lieutenant Hyman Samuelson reported to Fort Bragg, North Carolina, for duty with the 96th Engineer Battalion (Colored). A graduate of Louisiana State University with a degree in civil engineering, Samuelson was pursuing an advanced degree at Tulane when called to active duty.

The 96th was, like many units raised in the hectic days of mobilization prior to Pearl Harbor, a confusing composite of regular and reserve officers and enlisted men quickly brought into service with the minimum of training. As constituted, the 96th essentially was a general service battalion. These units were charged with construction duties, freeing the combat battalions to support the maneuver arms. In many instances, black engineer units were considered to be little more than labor battalions. Often they were short of the heavy equipment needed to meet their construction tasks. The overall lack of mechanical and technical peacetime training for many of the young black soldiers complicated the problem.

Gwendolyn Hall's book is, in reality, an edited printing of Samuelson's diary and the letters he sent to and received from his wife. This is one of the strengths of the work. Samuelson spent a lot of time describing his duties, the conditions he and his men labored under, and the tasks they accomplished. The book clearly shows the difficulties Samuelson had adjusting to the Army and the problems the 96th experienced both in training and during their service in New Guinea. As one of the first engineer units to arrive in New Guinea early in 1942, the 96th faced all of the problems of trying to perform engineer tasks in a primitive land, with little support and under the constant threat of air or ground attack. Limited recreational opportunities, including those imposed on the battalion because of segregation policies, often placed both officers and men under extreme personal pressure.

Through the diary and the personal letters, the reader can watch the maturation of a young man and the growth

of an officer and leader. The letters to his young wife (they were married only a few weeks before he went overseas) show the personal stress of separation from family. Many of his letters, and hers, are filled with personal feelings of love, anger, and fear, which are seldom printed in histories or biographies. The diary also reflects his growing confidence as an engineer and the admiration he came to have for his men. In 1943 he wrote, "Before I die I must help stamp out this crazy idea that white man has about his superiority over the colored man." The diary and letters also show how his understanding of leadership grew as he took on increasingly greater responsibility in the unit, ultimately serving as company commander.

Hall's *Love, War, and the 96th Engineers* is really several stories in a single volume. It is a story of a young engineer officer at war in the Southwest Pacific in World War II. It is also a story of a husband separated, by the war, from his wife and family for almost three years. It is equally the story of the 96th Engineer Battalion, as told by a young officer who is fiercely proud of his men, their capabilities, and their accomplishments. Because the book contains these different accounts, it has value to a wide audience. Young officers will benefit from Samuelson's trials and tribulations as a young company-grade officer. The leadership approach he developed is worth consideration. Senior leaders also will benefit from this book. Samuelson was quite pointed in his diary about the relative merits of his superior officers. The views of a junior officer concerning the leadership, professionalism, and personal strengths of his superiors often make interesting reading. Finally, the book will be of value to families. Dora Samuelson's thoughts and feelings about him and the difficulties of their separation are clearly shown in the letters to her husband. Although the world and society of the 1990s differ from those of the early 1940s, the personal equation of human beings and their families has not changed.

There is little in this book for those preoccupied with technology or the often sterile analysis of tactics and strategy. This is a human story.

Note: Engineer is seeking insightful reviews of books of special interest to military engineers. Contributions are welcome.

ENGINEER DOCTRINE PUBLICATIONS REDUCTION SURVEY

PURPOSE: The Training and Doctrine Command (TRADOC) has directed all U.S. Army schools to reduce the number of doctrinal publications by 20 percent and also reduce the content of doctrinal publications by 20 percent. This survey is a tool to request comments and recommendations concerning the feasibility of our consolidation plan to meet the reduction goal.

Unit _____
 Location _____
 Activity _____
 Duty Title _____

Name _____
 Commercial Phone No. _____
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Publications (*) under consideration for consolidation into one manual (**bold FM**) are indicated below. Using a scale of 1 to 5 (1 = the most acceptable for consolidating), please rank the logic of each planned consolidation and how well each will meet your needs.

<u>Number</u>	<u>Title</u>	<u>How logical is the plan?</u>	<u>How well will it meet your needs?</u>
1.	FM 5-170, Engineer Reconnaissance *FM 5-30, Engineer Intelligence *FM 5-36, Route Recon and Classification	_____	_____
2.	FM 5-250, Explosives and Demolitions *FM 5-250, Explosives and Demolitions *TC 5-250, Demolition Effects Simulator *TC 5-6-14, How to Prepare a Target Folder	_____	_____
3.	FM 5-446, Military Nonstandard Fixed Bridges *FM 5-134, Pile Construction *FM 5-446, Military Nonstandard Fixed Bridges	_____	_____
4.	FM 5-478, Construction Surveying *FM 5-233, Construction Surveying *TM 5-232, Elements of Surveying *TM 5-235, Special Surveys *TM 5-237, Surveying Computers Manual	_____	_____
5.	FM 5-420, Plumbing and Pipefitting *FM 5-163, Sewerage *FM 5-420, Plumbing & Pipefitting	_____	_____
6.	FM 5-474, Drafting *FM 5-553, General Drafting *FM 5-581B, Construction Drafting *FM 5-704, Construction Print Reading in the Field	_____	_____

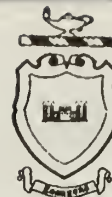
<u>Number</u>	<u>Title</u>	<u>How logical is the plan?</u>	<u>How well will it meet your needs?</u>
7.	FM 5-426, Carpentry and Masonry *FM 5-426, Carpentry *FM 5-742, Concrete & Masonry	_____	_____
8.	FM 5-434, Earthmoving Operations *FM 5-164, Tactical Land Clearing *FM 5-434, Earthmoving Operations	_____	_____
9.	FM 5-436, Paving and Surfacing Operations *TM 5-331D, Engineer Const Equip , Vol D *TM 5-337, Paving and Surfacing Operations *TM 5-337-1, Asphalt Plant Layout, 100T-150T	_____	_____
10.	FM 5-432, Pits and Quarries *TM 5-332, Pits and Quarries *TM 5-331C, Util of Engineer Const Equip, Vol C	_____	_____
11.	FM 5-540, Cartography *TM 5-240, Comp & Color Sep of Topo Maps *TM 5-243, Cartographic Aerial Photography	_____	_____
12.	FM 5-424, Theater of Opns Elec Systems *FM 20-31, Electric Power Generation in the Field *TM 5-760, Interior Wiring	_____	_____
13.	FM 5-410, Military Soils Engineering * FM 5-410, Military Soils Engineering * TM 5-545, Geology	_____	_____

Please explain why you think the consolidation will not work for any particular publication. Return completed survey to: Commandant, U.S. Army Engineer School, ATTN: ATSE-TD-D-WC (Lucius Warrick), Fort Leonard Wood, Missouri 65473.

This survey is available on the Internet at <http://www.wood.army.mil/DDD/ddd.htm>



DOCTRINE PUBLICATIONS SURVEY



PURPOSE: To better serve your needs for engineer doctrine manuals, the Doctrine Development Division of the Directorate of Training at the U.S. Army Engineer School requests your responses to the following questions:

Unit _____ Name _____
Location _____ Commercial Phone No. _____
Activity _____ Fax No. _____
Duty Title _____ E-mail _____

1. Does the current engineer doctrine hierarchy meet the needs of the field?

☐ YES.

☐ NO. If no, please state why.

2. Is engineer doctrine accurate in reference to how units operate in the field?

☐ YES.

☐ NO. Why?

3. Is engineer doctrine relevant to current missions required by engineer units?

☐ YES.

☐ NO. Why?

4. Does current engineer doctrine meet the needs of the entire engineer community?

☐ YES.

☐ NO. If no, what area(s) is missing?

5. Do you have access to the engineer home page digital doctrine?

☐ YES.

☐ NO.

If yes, circle the average number of accesses you make monthly.

(1 2 3 4 5 6 7 8 9 10 Over 10)

Circle the home page references that you most frequently use.

FMs STs TCs ARTEPs GTAs Lessons Learned

(File location of the homepage is <http://www.wood.army.mil/DDD/ddd.htm>)

6. Use a scale of 1 to 16 (1 = most useful) to rank the following manuals as to their usefulness:

- | | |
|--|--|
| ☐ FM 5-34, <i>Engineer Field Data</i> | ☐ FM 5-103, <i>Survivability</i> |
| ☐ FM 5-7-30, <i>Brigade Engr & Engr Co Cbt Opns</i> | ☐ FM 5-104, <i>General Engineering</i> |
| ☐ FM 5-71-2, <i>Armored TF Engr Combat Opns</i> | ☐ FM 5-105, <i>Topographic Operations</i> |
| ☐ FM 5-71-100, <i>Division Engr Combat Opns</i> | ☐ FM 20-32, <i>Mine / Countermine Operations</i> |
| ☐ FM 5-100, <i>Engineer Operations</i> | ☐ FM 5-250, <i>Explosives and Demolitions</i> |
| ☐ FM 5-10, <i>Combat Engineer Platoon</i> | ☐ FM 90-13, <i>River-Crossing Operations</i> |
| ☐ FM 5-100-15, <i>Corps Engineer Operations</i> | ☐ FM 90-13-1, <i>Combined Arms Breaching Opns</i> |
| ☐ FM 90-7, <i>Combined Arms Obstacle Integration</i> | ☐ FM 5-71-3, <i>Brigade Engr Combat Opns(Armor)</i> |



ENGINEER UPDATE

Commercial Numbers are (573) 563-xxxx and Defense System Network (DSN) numbers are 676-xxxx unless otherwise noted.

Fort Leonard Wood Electronic Addresses. Electronic mail that formerly went to users at *wood-vines.army.mil* has been changed to *wood.army.mil*. Mail addresses for users at *wood-emh1.army.mil* have been changed to *emh1.wood.army.mil*. For example, *doej@wood-vines.army.mil* becomes *doej@wood.army.mil*. POC is the DOIM Help Desk, -4357.

Fort Leonard Wood Web Server. Effective 15 July, the Fort Leonard Wood web server has a new look. Our name changed to reflect the Maneuver Support Center (MANSCEN) mission, a "topical" information layout provides easier navigation, and expanded coverage reflects our partnership with the Ozark community. Check us out at <http://www.wood.army.mil>. An electronic comment form is on the home page. POC is Greg Adank, -5368.

Department of Training and Doctrine Development (DOTD)

Field Manuals (FMs) Distributed. The following field manuals are scheduled for distribution this summer:

- FM 5-499, *Hydraulics*, is scheduled for distribution in August. This manual is a guide for personnel who operate and maintain military equipment using hydraulic-powered control systems.
- FM 5-424, *Theater of Operations Electrical Systems*, was distributed in June. It is a training guide for engineer personnel responsible for planning and executing construction in a theater of operations.
- Change 1 to FM 5-410, *Military Soils Engineering*, was distributed in June. This change incorporates applicable geologic information from TM 5-545, *Geology*, and supersedes the technical manual.
- Change 2 to TC 5-400, *Unit Leaders' Handbook for Environmental Stewardship*, was distributed in July. This change explains the terms "used oil" and "waste oil" and describes appropriate handling and disposal methods.

These manuals are on the Engineer School's Publications Page: <http://www.wood.army.mil/DDD/PUBS/pubs.htm>. POC is Lucius Warrick, -4115.

Updated Experimental Forces (EXFOR) Special Texts (STs). Special texts for company-, battalion-, and brigade-level EXFOR were updated in June based on the Advanced Warfighting Experiment (AWE) conducted in February. The revised STs will be used during the division-level AWE scheduled for November. They are on the Engineer School's Publications Page on the World Wide Web: <http://www.wood.army.mil/DDD/PUBS/pubs.htm>. POC is CPT Joe Birchmeier, -4115.

Staffing of FM 5-34. The draft of FM 5-34, *Engineer Field Data*, will be staffed to the field for comment using a combination of paper copies and the Internet. The draft was posted on the Engineer School's Publications Page (see above address) in June. Paper copies were distributed in July. POC is CPT Joe Birchmeier, -4115.

Directorate of Combat Developments (DCD)

Global Positioning System (GPS). Users of the GPS are reminded that the system is not accurate enough for precise minefield recording. Using GPS as the only means of locating or recording minefields will lead to avoidable injuries and deaths. Soldiers and civilian personnel must follow

approved tactics, techniques, and procedures when navigating or working near any known minefield. POC is CPT Rick O'Donnell, -5644

Engineer Force Structure. The Engineer School and MSBL are decisively engaged in a fight to retain engineer force structure at the division, corps, and theater levels. Proposed heavy division designs remove the engineer command group (colonel). Possible reductions in corps engineer force structure are being discussed by the TRADOC Force Design Directorate. General Reimer is scheduled to reach a decision on 11 August concerning the theater support command (TSC) concept proposed by the Combined Arms Support Command, which would place the engineer command under the command and control of the TSC. We are seeking support from fellow Army engineers in all components, including military retirees, in these fights. We are also soliciting help from theater commanders in chief and other combined arms partners. If you can assist or have questions, please contact us. The e-mail address is lowreyv@wood.army.mil. POC is Vern Lowrey, -4082.

Unmanned Terrain Domination. Now that the Cold War has ended and U.S. forces are drawing down, the U.S. Army is reexamining the way it trains and fights. The Army of the future will be smaller but more technologically advanced. Potential adversaries will not go away and they, too, are advancing technologically. Therefore, U.S. forces must dominate battlespace while maintaining economy of force. An integrated concept team is developing a concept for unmanned terrain domination as a capability for the Force XXI Army. In accordance with Joint and Army visions, this operational capability will provide the commander total situational awareness, the ability to evaluate data received from unmanned sentries and develop courses of action based on that data, and the ability to employ tactics and unmanned systems to achieve desired objectives. If you can assist or have questions, please contact us. The e-mail address is chapmant@wood.army.mil. POC is MAJ Tom Chapman, -5820.

Officer Restructure Initiative. General Reimer approved the Office of Personnel Management System (OPMS) proposal to restructure the officer corps' development system into a four-career-path system. The OPMS task force is focusing on restructuring branches and functional areas to implement the new system. The Engineer Branch has two key concerns: how to balance the large number of majors with the small number of branch-qualifying S3 and XO positions and if changes to current branch and command qualifications are necessary. For more information, refer to EPPO's home page: http://www.wood.army.mil/EPPO/epo_hp.htm. POC is CPT Matt Zajac, -4087.

Environmental Partnering Workshop. Reserve 21-23 October 1997 to attend a workshop sponsored by the Society of American Military Engineers (SAME) at Fort Leonard Wood. The workshop, "Environmental Partnering in Engineering Operations," will focus on environmental solutions to military engineering challenges. It will look across service boundaries and open channels to academia, the private sector, and non-Department of Defense government agencies with proven solutions to engineering problems. POCs are MAJ Jack Drolet, (573) 596-0224, and LTC Sue Myers, (573) 563-4106.

Maneuver Support Battle Laboratory (MSBL)

Engineer Personnel Proponency Office (EPPO)

News and Notes

Engineer School Directory

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563-4098

Engineer Professional Bulletin

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Engineer Branch Safety Office

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563-4025

Garrison Commander

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1st Engineer Brigade

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BRIDGE THE GAP

*By Command Sergeant Major Julius B. Nutter
U.S. Army Engineer School*

One Army, One Standard

To prepare the Total Army for the 21st century, TRADOC formed the Total Army School System (TASS). The system is designed to fix the problem of "nonstandardized" training for non-commissioned officers (NCOs) assigned to the Active, National Guard, and Reserve Components. In the past, NCOs attended Noncommissioned Officer Education System (NCOES) courses in either Active, National Guard, or Army Reserve academies. Because the courses for soldiers in the Active Component were considerably longer than those in the Reserve Components, training scenarios in the three academies differed significantly. Under TASS, the level of training NCOs receive will be more equal regardless of their component affiliation. TASS will minimize discrepancies by utilizing distance-learning media such as CD-ROMs, making courses available on the Internet, and conducting video-teleconferences.

To help standardize training, TRADOC established seven regions that cover the 50 states and seven territories. Under TASS, all initial entry training will continue to be conducted at the proponent schools, and reclassification training will be taught at a functionally aligned TASS school. Responsibility for combat arms training usually falls under the National Guard, while responsibility for combat support and combat service support falls under the Army Reserves. Although the Engineer Regiment is a combat arms branch, the Army Reserves have responsibility for engineer TASS training.

TASS is an integrated part of the training bridge between the Active, National Guard, and Reserve Components. The abutments of this bridge are built on seven regional training battalions. Structural members, such as partnerships, coaching, and leadership, are needed to span the gap. One of the Engineer Regiment's greatest challenges is to consolidate our resources and forge a true partnership that integrates the assets of each component to create one viable training organization.

What does this mean to the typical engineer NCOES candidate? Soldiers in both the Active and Reserve

Components can attend the resident course either at Fort Leonard Wood or any regional school. For example, starting in October 1997, the Total Army Training System (TATS) course "Combat Engineer" (Career Management Field 12, Advanced NCO Course) will be configured with the following academic hours: The resident course at Fort Leonard Wood will have 343 hours. The regional course will have two phases spread over two years. The technical phase has 283 hours—150 hours of active duty training (ADT), 123 hours of inactive duty training (IDT), and 10 hours of distance learning. The second phase, common leader training, includes about 85 hours of common tasks. It is taught by the professional development battalions and at the U.S. Army Sergeants Major Academy.

TASS is the Army's system for training, and our readiness is tied to the success or failure of this system. Partnerships similar to those created in capstone units provide the right environment for success. As with any new system, TASS requires structural support from all engineer leaders and trainers. Unit leaders must start coordinating with the Reserve Component training battalions at least a year in advance of the training to ensure that all requirements are resourced. Command sergeants major must ensure that their NCOs verify Army Training Resource Requirements System (ATRRS) listings of courses with the regional school battalions. They should reverify the course 60 days prior to the course date to ensure that soldiers do not show up for courses that have been canceled but not annotated in ATRRS. Soldiers must ensure they are prepared to attend the course by being physically fit and familiar with the program of instruction.

Training the engineer force for the demands of America's Army in the 21st century must include efficiencies because of reduced resourcing. As leaders, you are responsible for getting your soldiers trained. Implementation of TASS ensures that all engineer soldiers are trained to a single standard. It provides efficiencies by allowing students to get MOS qualified without having to travel great distances. We must bridge our training gap and remain a viable part of the combined arms team.

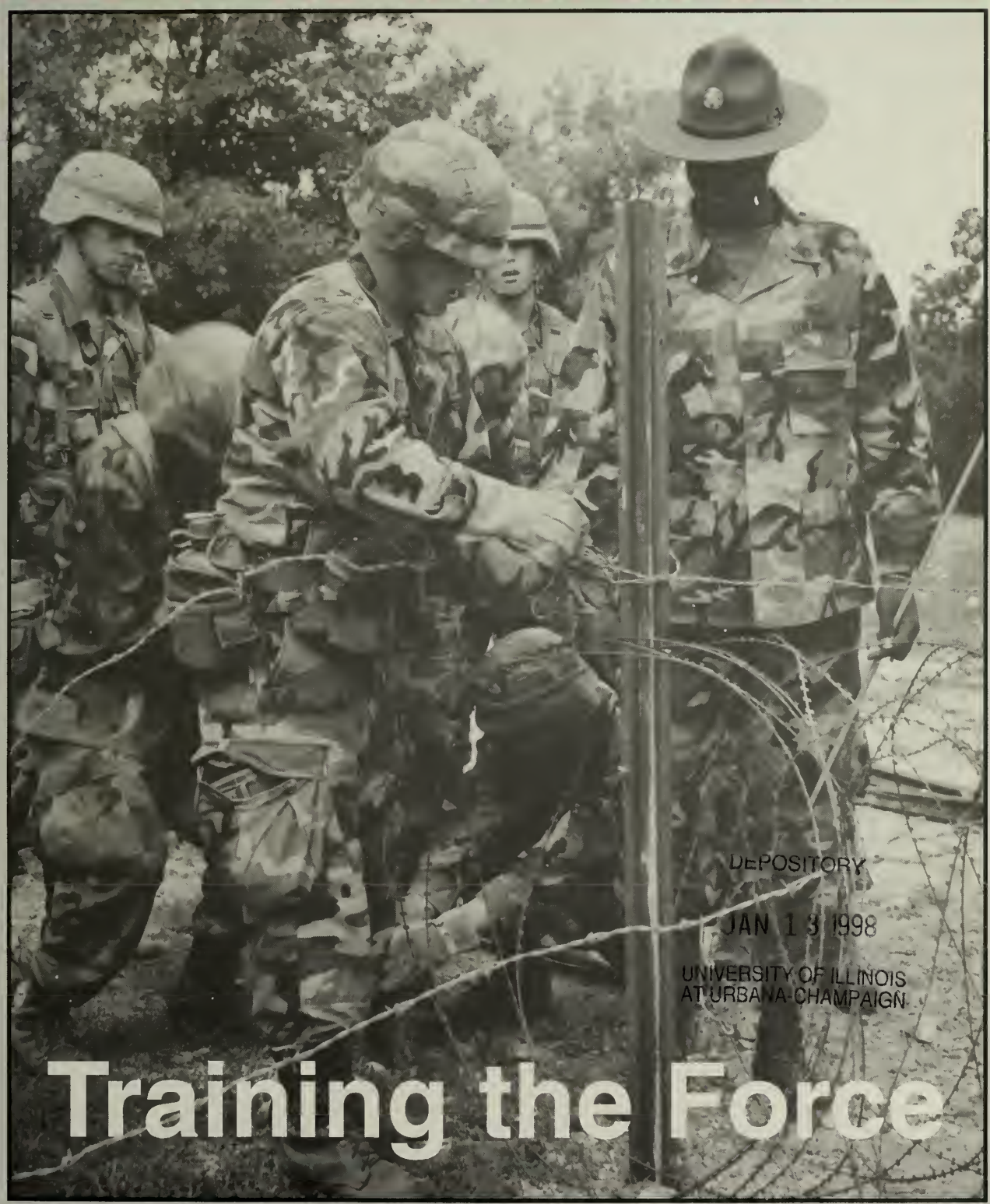


A stubby bulldozer driven by Navy Seabees puffs off an LST at Green Islands, Malaysia, during the invasion by Allied troops in February 1944.

Engineer

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AT URBANA-CHAMPAIGN

Training the Force



CLEAR THE WAY

By Major General Robert B. Flowers
Commandant, U.S. Army Engineer School

One of the giants of the Corps of Engineers departed from Fort Leonard Wood in July: MG Clair F. Gill. His vision, drive, and initiative forged the course for the Corps of the future while ensuring that we remained a vital part of the combined arms team. I have just reread his last "Clear the Way," which emphasized the "One Corps, One Regiment, One Fight" theme. I echo that message—the entire Corps must continue to speak with one voice. We have many challenges in today's changing world and we will succeed only if we all work together.

My personal "high ground" has three imperatives. The foundation for success requires that each of us maintain situational awareness, personal fitness, and technical competence. We are inundated with information, and the news media seem to report on new natural or man-made hot spots every day. The time to read about a crisis in Algeria, the role of the Taliban in Afghanistan, or the new Iranian missile threat is not when we receive an alert notification. Citizens of the world turn to the United States for leadership, and if we are not informed and ready, they will look elsewhere. Each of us must stay abreast of world events for our nation to remain relevant.

The second part of the success formula is personal fitness. A PT program combining strength and cardiovascular exercises improves overall stamina, but personal fitness is much more than that. Eating healthily, maintaining proper weight, and completing medical physicals on time are also important. Stress and high blood pressure are silent killers; heed their warning signs. If you have skipped PT, delayed your over-40 physical, or ignored high cholesterol levels, change today and get fit.

Our education system does a fine job of familiarizing each of us with our jobs, but technical competence is more than familiarization. Whether you are new or have been in the same job for years, learning never stops. To establish credibility in a new assignment, review and read ahead of time to be certain that you use the correct terminology and thoroughly grasp the subject. Once there, your goal should be to become the subject matter expert (SME) by continuing to read and research. If you are already an SME with years of experience, read to stay current with emerging technologies. One of our country's historical strengths is the ability to develop and apply new technologies to save time, money, and lives. The master craftsman making flintlock rifles became a curiosity with the advent of center-fire ammunition. If you have been in the same job for some time, don't be satisfied with making the best flintlock. Read and learn and you will continue to grow professionally.

Next, I need the help of every Army engineer. Top priorities for new engineer equipment are the Grizzly and the Wolverine, and both of these programs will require our

total support to survive future budget cuts. I charge every engineer to be an advocate and an ambassador for the Grizzly and the Wolverine. We must modernize! Our current breaching and bridging equipment is based on 1950's technology. This new equipment, based on the M1 tank chassis, is necessary to bring us into the 1990s. If we are to continue to contribute to the modern combined arms team, we must have the Grizzly and the Wolverine. The Grizzly provides (for the first time) armored protection for engineers to breach complex obstacles. Replacing many systems, this one vehicle can conduct a mounted breach in stride. Instead of a series of vehicles and dismounted squads separately breaching each part of the complex obstacle, the Grizzly will clear a lane through the minefield, breach the wire, fill the antitank ditch, and pull apart the log crib. The need for the Wolverine is clearly shown in the book *The Damned Engineers*, by Janice Holt Giles. In it, the *Kampfgruppe Peiper's* attack during the Battle of the Bulge failed because it could not cross a small stream. The 291st Engineers had blown the bigger bridges, and the smaller ones could not support the German tanks. Without organic, tactical bridging, the entire attack stalled. We must never let this situation occur in our Army. Bottom line: We need both the Grizzly and the Wolverine now.

Finally, in September I attended the Anti-Personnel Landmine Conference in Oslo, Norway. As the U.S. technical expert, I participated in many discussions our delegation had with other nations and nongovernmental organizations (NGOs). The end result was always the same: *Everyone*, to include the NGOs, agreed that the United States is not part of the problem, but most were reluctant to accommodate our concerns for fear of providing loopholes that others might exploit. This is just one battle in a long campaign to ban land mines. Expect more information later.

I applaud our President's decision not to sign the Oslo Treaty. He has put the lives of American soldiers first and shown he will not be overwhelmed by an international tide of well-meaning but misplaced efforts.

Fact: The United States spends as many dollars as the rest of the world combined to support demining operations even though none of the mines were made in the United States or emplaced by U.S. soldiers.

I am very honored to be the new commander at the home of the engineers. As MG Gill noted, we still face many challenges: the Divisional Engineer Brigade, joint doctrine, mine detection, resources, and many others. I look forward to successfully solving all of them. Fort Leonard Wood is a vibrant, growing post with a well-kept secret: It's a great place to train, raise a family, and serve our nation.

Engineer

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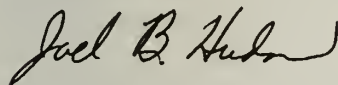
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*General, United States Army
Chief of Staff*

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*Administrative Assistant to the
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04115

Front Cover: One Station Unit Training (OSUT) soldiers learning to prepare a concertina obstacle. Photo by Jim Ray, TSC, Fort Leonard Wood.

Back Cover: D7 dozers on line ready for attack. Photo by Jim Ray, TSC, Fort Leonard Wood.

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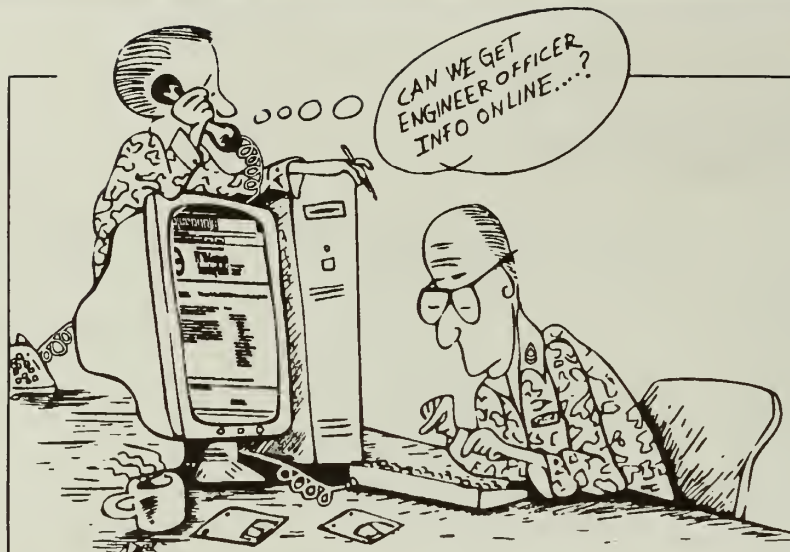
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A New Era Begins in the Personnel Realm

By Captain Matt Zajac

In today's era of reduced resources and escalating print costs, those of us in the personnel realm must determine how to disseminate information to the greatest number of people in the shortest amount of time. While we recognize the power of the Internet, we also recognize that not everyone has access to information posted electronically.

Personnel Update

With these concerns in the forefront, the Engineer Personnel Proponency Office (EPPO), the officer branch, and the enlisted branch proposed adding a new department—entitled "Personnel Update"—to the *Engineer Professional Bulletin*. The purpose of the "Personnel Update" is not to duplicate information available on the Internet but rather to focus on major issues facing the branch today.

This issue of *Engineer* includes articles on initiatives that have far-reaching impacts on both engineer officers and enlisted soldiers. The article on OPMS XXI (page 3) describes where we are and where we see ourselves headed, and "Changes in NCO Structure" on page 6 tells of our success during this endeavor. We ask you to take time to consider your future and provide EPPO some guidance. The EPPO staff will measure the success of the new department by the level of response received from you.

Internet Sites

Three Internet sites focus on engineer-specific personnel issues.

The *Engineer Personnel Proponency Office* maintains a site at http://155.9.32.3/EPPO/eppo_hp.htm. EPPO provides advice and assistance to the Engineer School commandant to attract, develop, and retain engineer officers, warrant officers, and soldiers. Typical articles cover the impacts of Department of the Army decisions on the branch, proposals on restructuring the branch, and "what-if" articles that ask field personnel where the branch should be headed. Topics currently at the EPPO site include creating a 12B additional skill identifier for combat engineer equipment, consolidating MOSs in the 62 series, and recent successes in expanding engineer Project Warrior positions to the Combat Maneuver Training Center and expanding Ranger coding in engineer units that support light, airborne, and air-assault infantry units.

The *Engineer Officer Situation Report (SITREP)*, which replaces the discontinued paper *Engineer Officer Bulletin*, is maintained by the Engineer Branch at PERSCOM. The *Engineer Officer SITREP* reports the latest engineer-specific information on schools, promotions, and assignments. From it you can access links to related home pages (such as Army, PERSCOM, Fort Leonard Wood, USACE, OPMS XXI, and the *Engineer Unit Directory*).

The *Engineer Officer SITREP* is published biannually and updated as necessary. Through this medium, the Engineer Branch continues to provide timely and accurate information, trends, and statistical data to assist officers in managing their careers. Current topics include results of the FY97 Advanced Civil Schooling/Small-Group Instructor/Observer-Controller and the Year Group '91 Functional Area Designation Boards and upcoming board dates. The SITREP is available at <http://www-perscom.army.mil/opmd/engineer/enbull.htm>.

The *Engineer Enlisted Newsletter*, maintained by the enlisted branch, focuses on information enlisted soldiers need to successfully plan their future. Articles in the current *Engineer Enlisted Newsletter* include information on adjustments to the Selective Re-enlistment Bonus, force structure cuts, and an after-action review from the last promotion board for sergeant first class. The *Engineer Enlisted Newsletter* is at http://www-perscom.army.mil/enlist/eng_ltr.htm.

Essays!

With the addition of this new department to *Engineer*, the personnel realm has gained an axis to ensure that you receive the information you need when you need it. As always, suggestions on ways to improve the Engineer Branch are welcome. Send correspondence to CPT Matt Zajac at zajacm@wood.army.mil.

OPMS XXI AND THE ENGINEER CORPS— WHERE ARE WE HEADING?

By Captain Matt Zajac

Since July 1996, PERSCOM's Officer Personnel Management System (OPMS) XXI Task Force has been analyzing the challenges facing the management and development of the Army's officer corps of today and tomorrow. After aligning these challenges with requirements posed by Force XXI, the task force formed a new vision and set of characteristics and established objectives for the officer development system.

First and foremost, the task force focused on creating a system that allows officers to remain in key developmental jobs for longer periods of time. Reduced personnel turbulence increases unit effectiveness and results in an officer corps with a greater depth of experience in each branch and functional area (FA).

Career Options

Relying heavily on input from the field, the task force created four career development system options for evaluation. The options range from merely adjusting

today's system to severing it into four separate career fields (CFs) that will align with the Army functions in 2010. In June 1997, the Army Chief of Staff directed the OPMS XXI Task Force to implement an officer development system structured around four career fields: operational, operational support, institutional support, and information operations. Figure 1 shows how today's system transforms to a four-career-field development system.

The Operational Career Field includes the basic branches, FA 39 (Civil Affairs), and the Special Forces Branch. They focus on functions associated with fighting and training the force. The Engineer Branch, including the U.S. Army Corps of Engineers (USACE), remains in this career field.

The Operational Support Career Field contains the Army Acquisition Corps and FA 48 (Foreign Area Officer).

The Institutional Support Career Field produces officers skilled in obtaining and managing resources that the Army requires. FA 45 (Comptroller), FA 47 (U.S. Military Academy Professor), FA 49 (Operational Research and Systems Analyst), FA 52 (Nuclear Weapons), and two new

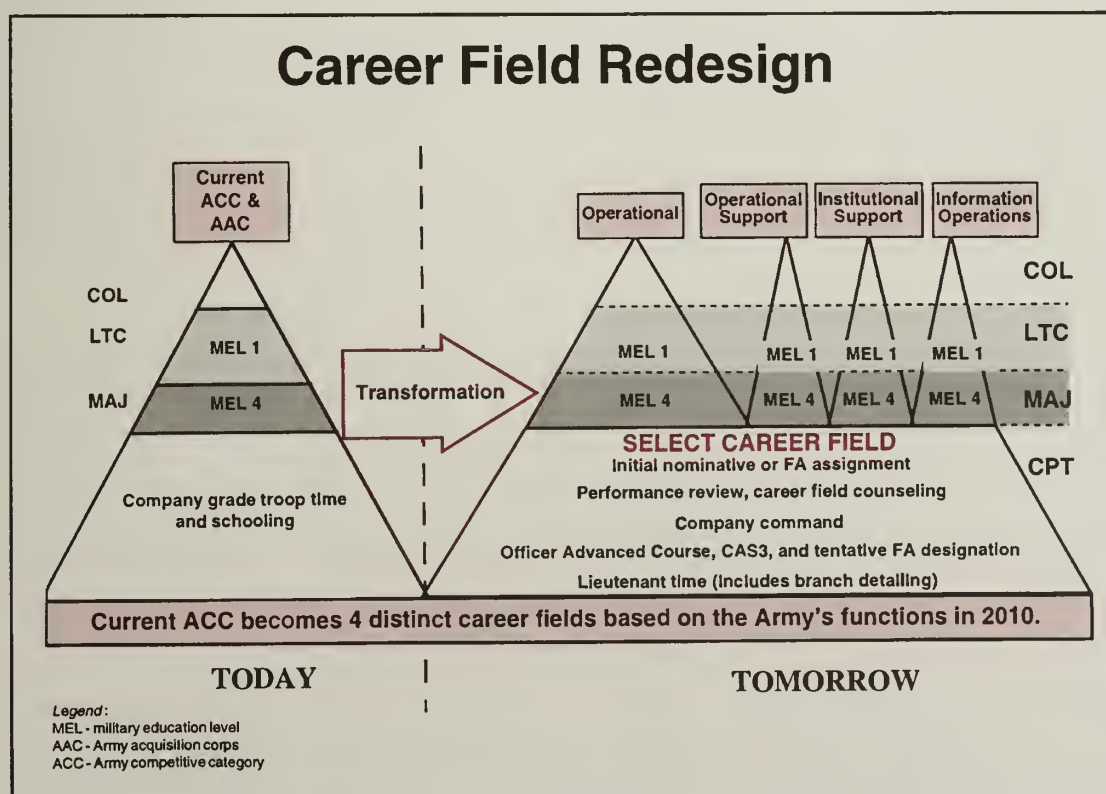


Figure 1

Career Field Designation Process

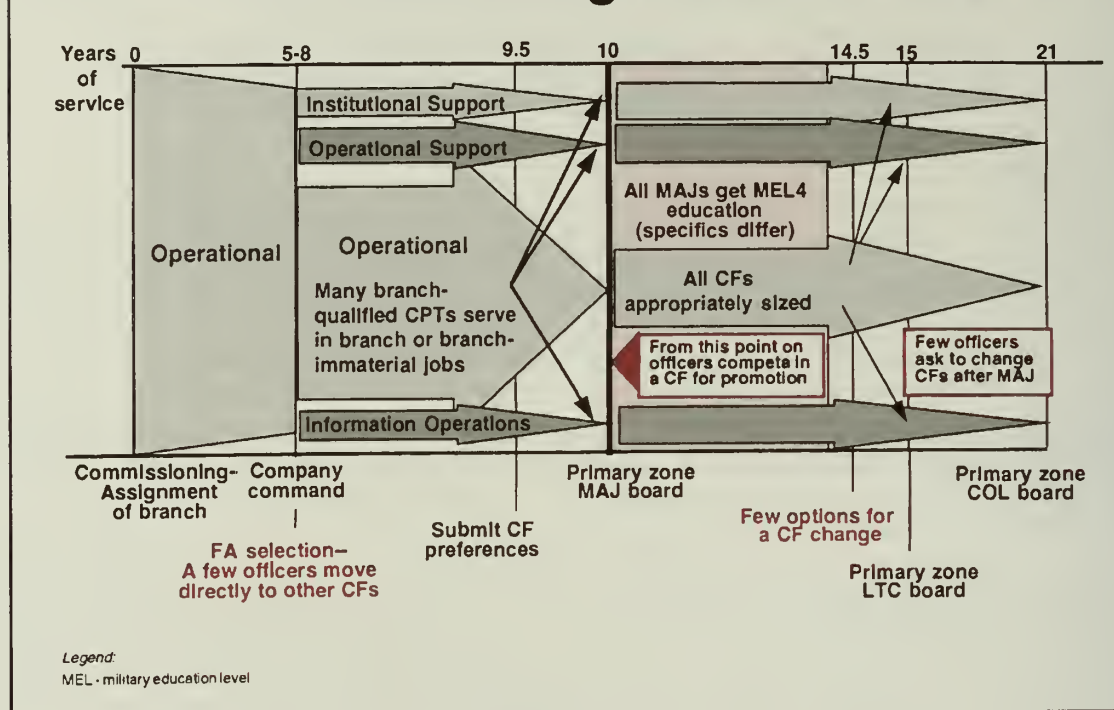


Figure 2

functional areas—FA 43 (Human Resource Manager) and FA 50 (Force Developer)—are grouped in this career field.

The Information Operations Career Field recognizes the Army's requirement for specialists skilled in collecting, organizing, processing, and disseminating intelligence across the full spectrum of the human, signal, and electronic information bands. The current FA 46 (Public Affairs) and FA 53 (Automation Systems) are joined with four new functional areas related to the collection and analysis of strategic intelligence, modeling and simulations, space-based operations, and the integration of information operations in support of joint/component commanders.

Focusing

Figure 2 shows how the proposed officer development system separates officers into the four career fields. Recognizing the necessity for grounding Army officers in solid, leadership-developing platoon and company experiences, the task force proposed a system that maintains the current, familiar initial developmental pattern. Officers continue to enter the Army with a branch designation and serve in that branch until they complete company command. Then (about their fifth year of service) they select a functional area. Single tracking will no longer exist. The functional area choice, their personal goals, and performance counseling will guide the officer's career into one of the four career paths. The path is permanently

designated after their primary zone promotion to major. From this point on, they are promoted and selected for schooling from only the officers in their career path. No longer will there be "double" looks for promotion or schooling, which is possible now because of separate basic branch and functional area boards. Limited opportunities will exist to change career paths after selection for major. The new system allows officers with the desire and aptitude for performing roles outside of today's command track to continue to hone their skills, compete for challenging assignments, and serve the Army and the nation.

Challenges

The Engineer Branch faces two key challenges as we move toward OPMS XXI. The first is our need to remain one regiment. By aligning the entire engineer force under the operational force, the branch averted the consequences of an early task force recommendation to create a separate functional area, in a separate career field, for USACE officers. The current focus is to balance the officer inventory with our requirements and authorizations. The task force's recoding initiative directs that branch proponents review their authorizations and, with specific guidance, determine which positions can be recoded. These recoded positions will help the task force develop the new functional areas and create viable career opportunities for each career field. The Engineer School's Personnel

Proponency Office is reviewing the branch authorizations and will brief the Deputy Chief of Staff, Personnel, on 10 December 1997.

Our second challenge is a function of our diverse assignments. The Engineer Branch is struggling to branch-qualify all of our majors with the few branch-qualifying (S3/XO) positions available. This shortage has resulted in an unacceptable level of unit turbulence, with engineer majors serving barely 12 months in these key developmental positions.

So how does the Engineer Branch develop officers and then increase their depth of experience? Perhaps by expanding the definition of "branch qualification" to include certain USACE positions and division staff positions (such as assistant division engineer). We must also determine lieutenant colonel/colonel "command qualification" and if there are any formally recognized paths to either the table of organization and equipment (TO&E) or the USACE commands. Balancing the qualification of engineer officers while maintaining one regiment remains fundamental to our branch's success as OPMS XXI evolves.

Supporting Force XXI

The Army faces major challenges in the years ahead. The OPMS XXI Task Force and the Engineer Branch have made significant progress toward an officer development system that supports both the Army's future vision and the needs of today's engineer officers. Our success during this redesign period is a direct result of your input. With your support, tomorrow's Engineer Branch will continue to provide officers unparalleled challenges and unequaled job satisfaction. Equally important, we will ensure that the Engineer Corps remains ready to meet the nation's challenges in the future.

For more information on OPMS XXI, refer to the Engineer Personnel Proponency Office's home page: http://www.wood.army.mil/EPPO/epo_hp.htm.

We welcome suggestions on forming our future officer career development pattern. The point of contact is CPT Matt Zajac at DSN 676-4087 or commercial (573) 563-4087. The e-mail address is: zajacm@wood.army.mil.



Captain Zajac, officer coordinator in the Engineer Personnel Proponency Office, has coordinated USAES efforts with the OPMS XXI Task Force for the past 18 months. Previous assignments include commander, C Company, 2d Engineer Battalion, Korea; executive officer, 362d Engineer Company (CSE), Fort Bragg, North Carolina; and platoon leader, 264th Engineer Company (MGB) during Operations Desert Storm and Desert Shield. CPT Zajac holds a bachelor's degree in civil engineering from the University of Illinois and is completing a master's degree in engineering management from the University of Missouri at Rolla.

Carrying Your Concerns Forward

By Captain Matt Zajac

On 15 October 1997, MG Robert B. Flowers, Commandant, U.S. Army Engineer School, presented the 1997 Functional Review (FR) to LTG Frederick E. Vollrath, Deputy Chief of Staff, Personnel (DCSPER). As the personnel predecessor to the annual Functional Area Assessment (FAA), the FR allows the DCSPER to address issues within the personnel arena before they are presented to the Vice Chief of Staff of the Army during the FAA. The commandant and representatives from the officer, warrant officer, and enlisted branches; the Office of the Chief of the Army Reserve; and the National Guard Bureau presented their assessments of and concerns about the engineer force.

Enlisted Concerns

MG Flowers stated that the shift of 76 percent of the engineer force to the Reserve Component during the drawdown has affected the branch's ability to rapidly respond to and maintain support for extended stability and support operations. A prime example of this challenge is the personnel status of our active duty bridge units. The 12C military occupational speciality (MOS) continues to experience an initial-term retention rate average of only 33 percent (FY96 to present) and only a 14-month CONUS tour stabilization. Low initial-term retention rates during FY97 for MOSs 12B, 51M, 51T, and 81T were also discussed.

The continuing shortage of active duty master sergeants and sergeants major in career management fields (CMFs) 12 and 51 is another concern. Promotion rates have exceeded the Army's average since June 1996, but retention rates are well below average.

Another enlisted concern is the Department of the Army's elimination of the 285th Engineer Detachment (Quarry). While the Reserve Component still has significant quarry assets, the Active Component cannot maintain viable career progression for this MOS (only 16 authorizations remain). Our challenge now is to identify how to train and support those units in the Reserve Component.

Officer Concerns

Engineer officers are concerned about the effects of OPMS XXI and the Officer Restructuring Initiative (ORI) on the branch's structure and career progression. Other concerns are the diversity of the branch—particularly with regard to developing and retaining female and African-American field grade officers—and the continuing shortage of branch-qualified captains. In response to these last two concerns, MG Flowers requested that PERSCOM initiate a *Call to Active Duty* for engineer officers who have recently left the service. LTG Vollrath agreed in concept but directed that the effects of OPMS XXI and ORI authorization reductions be studied before bringing officers back to active duty.

Changes in NCO Structure (CINCOS)

By Sergeant Major John Murphy

When an *Army Times* article reported in June 1997 that an estimated 8,700 Army NCO jobs would be eliminated in an effort to trim the NCO content from 50 to 47.5 percent, the Engineer School and the Engineer Branch received an avalanche of phone calls, e-mail, and letters expressing grave concerns about potential cuts.

The school's Engineer Personnel Proponency Office (EPPO) is pleased to report that the engineer force is in an exceptionally stable position and, because of the bottom-up review of each engineer military occupational specialty (MOS) during the Changes in Noncommissioned Officer Structure (CINCOS) initiative in 1996, promotion opportunities will increase in most MOSs. The engineer leadership worked long and hard to prepare a proposal that meets the Army's needs, provides balanced career progression, and enhances the branch's ability to meet its diverse missions as we move into the next century.

CINCOS Review

On 18 June 1996, the Deputy Chief of Staff for Personnel (DCSPER) directed all personnel proponencies to conduct a bottom-up review of every MOS. This initiative, termed the CINCOS, resulted from a \$170 million reduction in the Army personnel budget. The guidance was to align MOSs with the Army's goal of a 47 percent NCO structure. However, the DCSPER realized that some MOSs would have higher or lower percentages, depending on their mission requirements. The guidance also allowed proponencies to correct stagnation in MOSs that historically displayed poor promotion opportunities.

CINCOS Proposal

EPPO began its analysis immediately. The first challenge was to determine where to trim, since the engineer force's NCO content was already at 44.7 percent. The Engineer School formed a task force to analyze each MOS from the bottom-up. EPPO's proposal focused on table of distribution and allowances (TDA) authorizations, so it had only a minor impact on table of organization and equipment (TO&E) structures.

In August 1996, a board of command sergeants major, which included the engineer sergeant major, reviewed the proposal for its impacts on combat readiness and career progression. The board's final adjustments resulted in a proposal that—

- Provided the overall engineer force with better career progression.
- Fixed two MOSs that historically had poor career progression.
- Enhanced the capabilities of the warfighting force.

The DCSPER accepted the engineer CINCOS proposal on 21 May 1997, with an implementation date of 1 October 1998. This initiative will affect promotions early in FY98.

Career Management Field (CMF)

12. The CINCOS proposal for CMF 12 restructured 123 positions and transferred 40 staff sergeant positions to MOS 62N Construction Equipment Supervisor. The positions affected were 38 MOS 12Z Combat Engineer Senior Sergeants, who were intelligence sergeants in the battalion and brigade S2 sections. Those positions were reduced from master sergeant to sergeant first class. Thirty-eight staff sergeants in Active and Reserve Component observer/ controller positions were

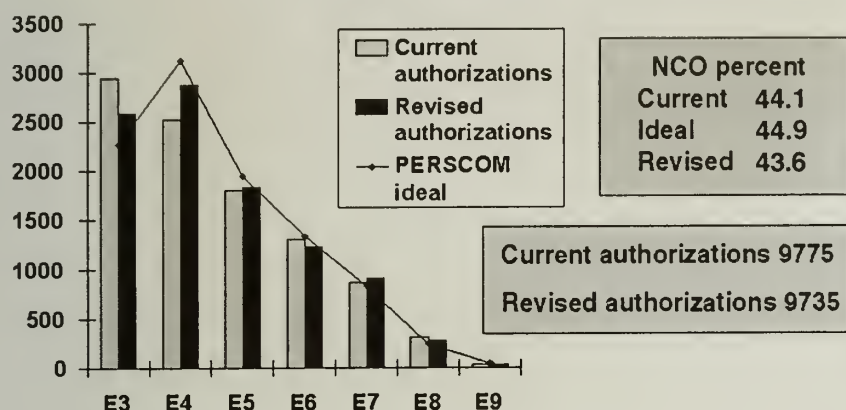
reduced to sergeants, because the senior NCO board believed it was within a sergeant's capability to complete that mission. As for MOS 12C Bridge Crew Members, Bosnia highlighted a requirement for a senior boat operator in our bridge units; therefore, 20 sergeants were upgraded to staff sergeants and given the title of Senior Boat Operator. The need for more skill level 10 boat operators resulted in 27 sergeant positions being downgraded to specialist. These adjustments balanced out career progression in MOS 12C. Finally, recognizing the disproportionate number of MOS 12B Combat Engineer E3's waiting for the opportunity to pin on E4 rank, CINCOS allowed 350 E3 positions to be upgraded to E4.

CMF 12 currently has an NCO strength of 44.1 percent and, after implementing CINCOS, will shift to 43.6 percent.

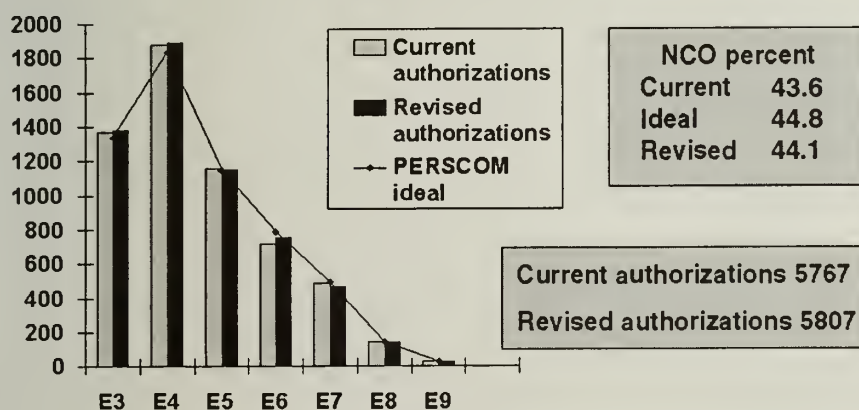
CMF 51. The bottom-up review revealed that in CMF 51, 30 positions from MOS 51H Construction Engineer Foreman in garrisons and Departments of Public Works could be downgraded from sergeant first class to staff sergeant, because staff sergeants possess the level of technical expertise needed to perform this function. Historically, MOS 62N displayed a poor promotion rate, and the DCSPER's guidance allowed this problem to be rectified. A total of 99 sergeant first class and staff sergeant positions were transferred to MOS 62N from MOSs across the engineer force: 54 from 51H, 40 from 12B, two from 51M Firefighter, and three from 51T Technical Engineering Specialist. Transferring these positions does not completely fix the current stagnation problem, but it improves career progression for 62N soldiers.

CMF 51's current NCO content of 43.2 percent will be increased to 43.5 percent.

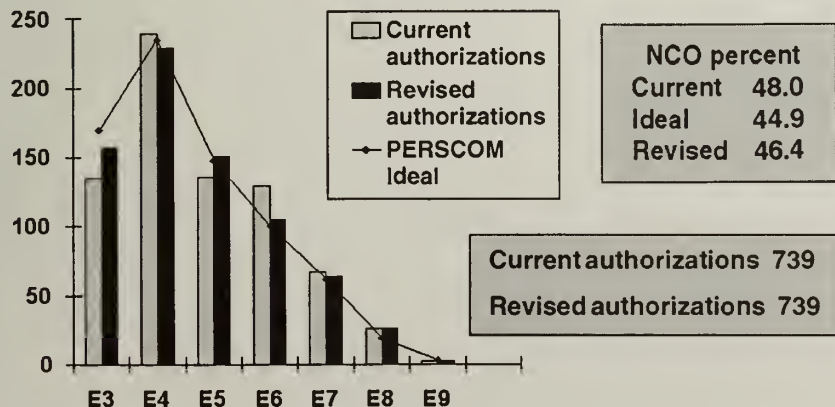
CMF 12 Recap



CMF 51 Recap



CMF 81 Recap



CMF 81. The CINCOS review affected 20 positions in CMF 81. Ten MOS 81L Lithographic Operations Sergeant positions in battalion S3 sections shifted from staff sergeant to sergeant. Two MOS 82D Topographic Surveyor positions in the Aerospace Activity in Saint Louis and eight battalion S3 Survey Operations Sergeants were reduced from sergeant first class to staff sergeant.

CMF 81's current NCO strength of 48 percent was reduced to 46.4 percent.

Career Progression

The three bar graphs depict the changes to career progression for the Engineer Corps. PERSCOM's guidance to the EPPO is represented by a single line across the top of each graph. This ideal line provides the best career growth for a particular CMF. The light gray bars indicate total positions at the present time (August 1997). The black bars represent the changes made by CINCOS.

As indicated by the graphs, the changes being implemented bring our engineer CMFs either to the ideal line or very close to it. This means that our MOSs will offer reasonable promotion opportunities well into the future.

The CINCOS initiative does not hinder engineer promotions, reduce job opportunities, or eliminate any positions. The majority of changes to engineer NCO strength are in positions where there is redundancy of leadership and an excess of technical expertise. The CINCOS initiative allows the Engineer Personnel Propensity Office to increase both promotion opportunities and the combat readiness of the Engineer Corps.



Sergeant Major Murphy is assigned to the EPPO. Previous assignments include operations sergeant, A Company, 864th Engineer Battalion, Fort Lewis, Washington. He is a graduate of the Advanced Noncommissioned Officers Course and the Operations and Intelligence Course. SGM Murphy holds an associate degree from Perice College, Tacoma, Washington.

Marine Engineers:

Developing a Strategic Vision for Engineer Support

By Major Jay E. Johnson

For several years the U.S. military engineering community has struggled to speak as one voice and attack from a united front. As we move into the 21st century, it is time for Marine Corps engineers to move forward and prepare to support Operational Maneuver From the Sea (OMFTS), as described by the Commandant of the Marine Corps in a 1996 White Letter. This Navy/Marine Corps concept builds on the foundation laid by two earlier documents: "From the Sea" (1992) and "Forward From the Sea" (1994). These documents present landmark shifts in operational focus and a reordering of coordinated priorities for naval forces engaged in forward areas. Their objectives are to prevent conflicts and control crises in areas known as the "chaos of littorals," which refers to chaos in shore or coastal regions. OMFTS is the centerpiece of our preparations for future expeditionary, littoral, and amphibious warfare.

Principles of OMFTS

Operational Maneuver From the Sea describes the Marine Corps' concept for the future. It—

- Focuses on an operational objective.
- Uses the sea as maneuver space.
- Generates overwhelming tempo and momentum.
- Pits strengths against weaknesses.
- Emphasizes intelligence, deceptions, and flexibility.
- Integrates all organic, joint, and combined assets.

To remain a relevant military engineer force in the future, all military engineers must be able to "deal explicitly with the full spectrum of challenges that we will have to face, the dangers and opportunities created by new technologies, and the very exciting prospect of adapting the tradition of maneuver warfare, not merely to amphibious operations, but to all aspects of warfare in, and around, coastal waters." (OMFTS, 1996)

Marine Engineer Vision

With the OMFTS concept in mind, Marine Corps engineers landed 28 July 1997 on Camp Lejeune, North Carolina, to conduct the Naval Expeditionary Engineering Conference. Participating in the conference with us were guests from the Navy Seabees and Army engineers from the 20th Engineer Brigade, the U.S. Army Engineer Center, the XVIII Airborne Corps, and the U.S. Army Corps of

Engineers. Our mission was to develop a common Marine Corps vision for engineer support, identify strengths and weaknesses in engineer support, and establish critical issues and objectives for engineer support. Armed with that information, we will soon develop strategies and action plans that will lead to our campaign plan for naval expeditionary engineering support to the Marine Air/Ground Task Force (MAGTF). The intent of the week-long conference was to both inform and guide the advancement of Marine engineer issues (doctrine, organization, training, equipment, and support) in the context of joint engineering and the Marine Corps development process to create a strategic plan. That plan will serve as our azimuth for the 21st century.

This was not a "typical" conference with numerous speakers where attendees reunite with old friends. Under the tutelage of Colonel Phillips, Commanding Officer of the Marine Corps Engineer School, we quickly realized that this was a working conference with a specific goal: to unite the engineer community by creating a strategic vision for the Marine Corps that encompasses and has applications across the other services.

The Marine engineer vision is to—

- Deliver focused engineering support across the total spectrum of military operations.
- Provide flexible, mobile force multipliers.
- Provide units that are sized to get to the fight with the capability of supporting sustained operations.
- Support MAGTF joint and combined operations.
- Enhance momentum, sustain the force, shape the battle, and win!

This vision is a beacon that demonstrates the Marine Corps' commitment to a joint engineer environment.

Challenge

For success in future conflicts, all U.S. military engineers must have the capability to link with the MAGTF and combine into a relevant combat force multiplier that the joint commander can bring to any mission. The full spectrum of conflict has no limits; it encompasses an asymmetrical enemy that may range from humanitarian relief to full-scale war. Engineers must be prepared to operate in a seamless, interoperable environment and have a diverse structure that is task organized to support the MAGTF and joint commands.

Opportunities

With this new challenge come new opportunities to exploit and add to our "tool box." For example, we must create new doctrine that supports OMFTS and develop or procure assets that provide adequate force protection. By tailoring our engineer capabilities to fit the mission, we will maximize our efforts and "showcase" engineers as the force multiplier for today and tomorrow.

To fill the doctrinal void, joint service engineers recently received approval to publish Joint Publication 3-34, *Engineer Doctrine for Joint Operations*. The initial draft of JP 3-34 is due out for review in November 1997. This publication outlines engineer fundamentals, organizations, planning, operations, and the capabilities of all service engineers for the joint force commander and his staff. It supplements two other joint doctrinal publications with an engineer focus: JP 4-04, *Joint Doctrine for Civil Engineering Support*, and JP 3-15, *Joint Doctrine for Barriers, Obstacles, and Mine Warfare*. These publications provide the joint force commander with the tools he needs to maximize engineer efforts and make them a true part of the joint team.

Some opportunities are already a reality. Interservice engineer training has been conducted at Fort Leonard Wood, Missouri, and other locations since October 1995, and we are developing training exercises that will strengthen our complementary capabilities with all services.

Our Marine engineer vision sets the stage for a new era of naval expeditionary engineering. Now we must revise the role, training, equipment, and structure of Marine engineers to more fully support OMFTS and joint operations. This should be done gradually in a continuous process rather than take quantum leaps that create a major event. A gradual, well-planned process will ensure that Marine doctrine and the new assets we procure adequately support and keep pace with OMFTS and the other services.

Role. The Marine engineer role is clearly defined by our four basic pillars (mobility, countermobility, survivability, and general engineering). These pillars will not change. However, we require further amplification on how our role will support the evolving tactics and operations required for OMFTS. First we must develop tactics, techniques, and procedures (TTPs) that will help define the engineer role in supporting OMFTS. Then we must test and validate our TTPs and inform the MAGTF of our capabilities. Until the Marine engineer role in supporting OMFTS is clearly defined, we should not develop a unified priority list relative to funding, personnel, equipment, and training.

Training. As MAGTF tactics evolve, we must reorient Marine engineer training to support OMFTS. If we do not adequately train Marine engineers to support the OMFTS, we will cease to be a combat multiplier in joint

environments. It is critical that we revise and modify the current engineer training program of instruction and individual training standards at our formal schools and Fleet Marine Force units to sustain OMFTS.

Equipment. Current equipment and resources do not provide Marine engineers sufficient capability to support the MAGTF or the joint community. We must review the MAGTF table of equipment with regard to ground tactical mobility requirements and develop an armored engineer vehicle for use in highly mobile environments. One option may be to develop an engineer variant of the Advanced Amphibious Assault Vehicle. We must develop a united Marine engineer Program Objectives Memorandum strategy to procure equipment that supports OMFTS and joint missions, or we will continue to be left scrounging for crumbs at all future congressional funding hearings.

Structure. Finally, the current organization of Marine engineer units may not adequately support future operational concepts of OMFTS and joint missions. To be effective, Marine engineer units must be structured to support the dynamics of the MAGTF, OMFTS, and joint commands. We must formulate an analysis tool to validate future operation concepts in their planning stages. These analyses should indicate how to revamp the Marine engineer structure to fully support OMFTS and joint operations.

Setting the Course

The July 1997 conference was successful in that it gave our engineer community a shot in the arm or wake-up call upon which we can build for the future. We Marine engineers now must focus on our vision and implement an engineer campaign plan. An engineer steering group (consisting of six colonels, one Navy captain, and one GS-15 civilian) was introduced at the end of the conference. This group will guide our community; the executive-level decision makers; Headquarters, Marine Corps; the Marine Corps Combat Development Center; Marine Corps Systems Command; and Marine forces in accomplishing this mission.

As the conference came to a close, we were reminded to "be patient, work the tactical issues, and spread the word of our campaign plan." That plan will unite our engineer community as one voice and not only support but lead the way in OMFTS for others to emulate.

Major Johnson serves as commanding officer, Engineer Equipment Instruction Company, Marine Corps Detachment, U.S. Army Engineer Center, Fort Leonard Wood, Missouri. He previously served as Combat Engineer Company Executive Officer, Combat Assault Battalion; Engineer Support Company Commander; S4, 3rd Combat Engineer Battalion, 3rd Marine Division, Okinawa, Japan. MAJ Johnson holds a master's degree from Webster University.



Training Combat Engineers the OSUT Way

By Captain Lawrence Farrell

30 March 1997, 10:05 hours: CPT Striker was not pleased; his armored vehicle-launched bridge (AVLB) maintenance readiness rate was 49 percent for the month. When he briefed the company's highlights, the battalion commander wanted to know if all the AVLBs had two soldiers assigned to them. Striker answered, "No." Irritated, the battalion commander asked, "Why don't you fully man your AVLB crews?" CPT Striker's reply was, "Sir, I am at 85 percent strength. If I fully man my AVLBs, I won't have six trained engineer squads for the upcoming National Training Center rotation." The battalion executive officer interjected, "Your company is getting six new 12B soldiers today from the replacement center. That should help alleviate your personnel problem."

Later, as CPT Striker walked into the company orderly room, the first sergeant approached and said, "Sir, here are Alpha Company's six soldiers." Half-seriously, CPT Striker asked two of them, "How much AVLB training do you have?" The first soldier replied, "Sir, I have three hours of stick time

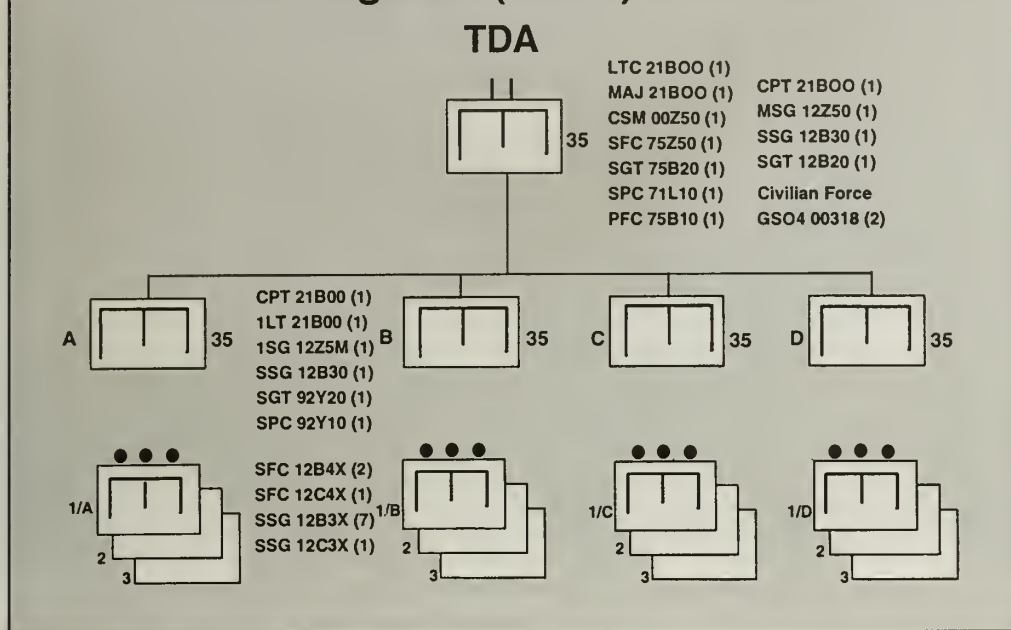
in an AVLB." The second soldier answered, "Sir, I have nine hours of stick time in an AVLB." CPT Striker was more than a little confused. He asked his first sergeant, "Top, did both of these soldiers graduate from the same 12B school at Fort Leonard Wood?"

Training Structure

This article provides an update of the current combat engineer career management field (CMF) 12 training at Fort Leonard Wood. Unlike other engineer training there, combat engineer training is not a joint effort among the four services. It is only offered to Army soldiers.

All CMF 12 training conducted at Fort Leonard Wood occurs in a One-Station Unit Training (OSUT) environment—the Army's method of combining basic combat training (BCT) with advanced individual training (AIT). OSUT provides the following benefits:

35th Engineer (OSUT) Battalion



- It is relatively inexpensive compared to other training. Soldiers performing OSUT at Fort Leonard Wood do not travel between posts during BCT and AIT. However, soldiers who graduate from BCT at Fort Jackson, South Carolina, are shipped to different posts around the country for AIT. Besides the obvious savings on travel costs, many hidden expenses are saved in an OSUT environment. For example, soldiers do not draw and clear equipment from the central issue facility twice or obtain a set of orders for each type of training. When viewed on an Armywide basis, the time, money, and effort saved quickly become enormous. OSUT also allows the unit to focus on additional training.
- It allows units more time to mold and train soldiers than BCT, which lasts only eight weeks. With OSUT, engineer companies keep soldiers from reception to graduation. The two OSUT engineer battalions at Fort Leonard Wood—the 35th and the 169th—have identical tables of distribution and allowances and both are part of the 1st Engineer Brigade.

OSUT companies are authorized 17 permanent-party soldiers: 11 drill sergeants and six headquarters personnel (see figure). One drill sergeant is always off because of charge of quarters, leaving 10 available for training. Each company is structured to have three platoons at full capacity with three or four drill sergeants in each platoon. OSUT companies have the same standards as any other unit in the U.S. Army. They have brigade, battalion, and post inspections as well as the more routine requirements (such as officer and NCO development classes, mandatory training requirements, family support group meetings and activities, and a variety of other events). When these responsibilities are

viewed collectively, it is understandable why drill sergeants earn an additional \$275 per month as "Special Duty Pay."

Training Phases

OSUT is divided into five phases. Phases I through III occur in BCT and Phases IV and V occur in AIT. Although not the official names of each phase, the following descriptions accurately portray the training soldiers receive.

Phase I: Soldierization and Common Task Training

Phase II: Weapons Training

Phase III: Fire and Maneuver Training

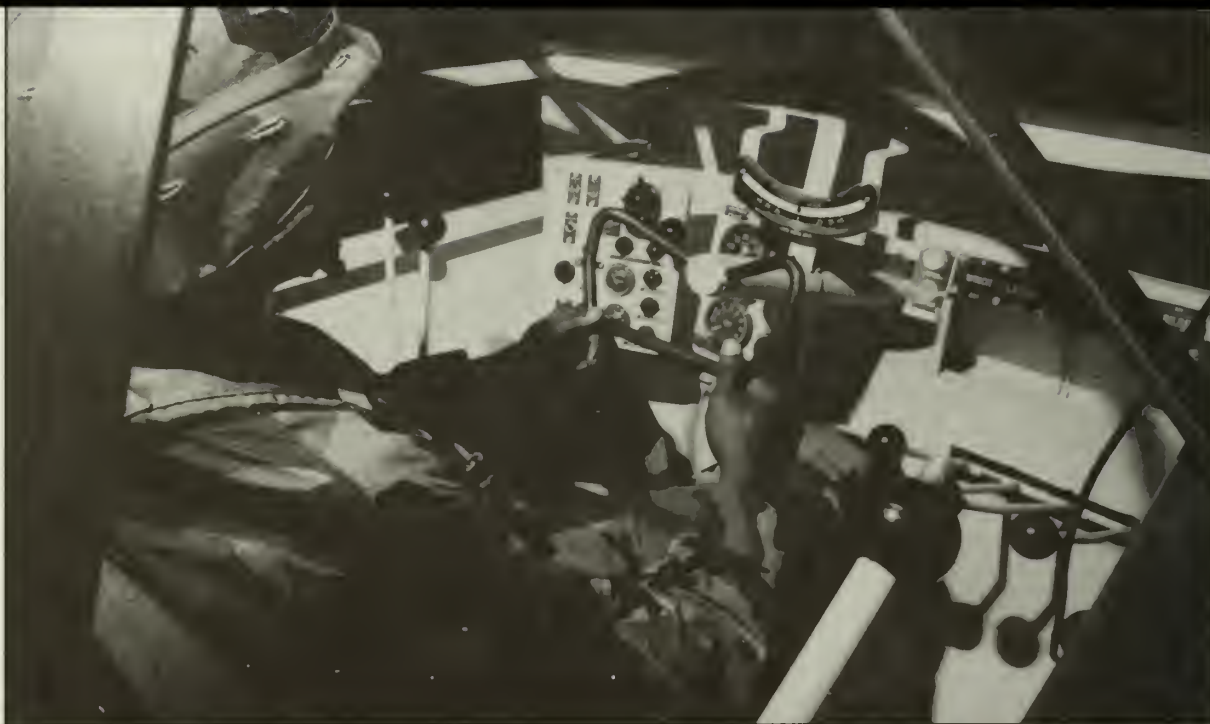
Phase IV: Light Engineer Training

Phase V: Mechanized Engineer Training

BCT Phases

Phase I. Soldierization lasts 14 days and focuses on basic soldiering skills. It includes more than thirty subjects, such as drill and ceremony; wearing and appearance of the Army uniform; first aid; map reading; nuclear, biological and chemical procedures; Army family team building; and environmental awareness. Soldiers train continuously for 14 days and are constantly in the drill sergeant's presence. This is the most critical training phase, because it provides the foundation on which all follow-on training is based.

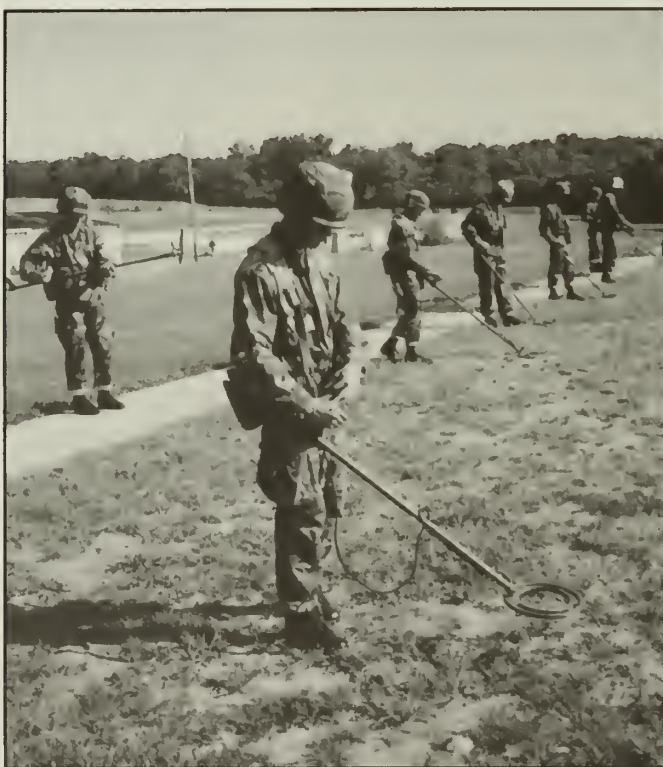
Phase II. Weapons training lasts 11 days and teaches soldiers to properly fire, maintain, and qualify on the M16A2



A soldier trains on the AVLB simulator in an indoor environment.

semiautomatic rifle—a requirement for successful phase completion. It also familiarizes soldiers with other weapons, such as the M203 grenade launcher, the M249 semiautomatic machine gun, and the M60 automatic machine gun.

Phase III. Fire and maneuver training introduce soldiers to live-fire ranges and grenades and their first field problem. During this phase, soldiers are aggressively and repeatedly tested on their ability to shoot, move, and communicate.



OSUT training includes training with mine-detection systems.

They train at five live-fire ranges to hone this skill. Soldiers must qualify on two hand-grenade ranges—live-fire and combat assault (inert)—to successfully complete this phase.

At the end of Phase III, soldiers must pass two more tests to move into the AIT portion of the OSUT cycle. They must score at least 80 percent on the End-of-Cycle Test, which serves as a final exam for BCT and ensures that each soldier knows how to execute basic combat tasks on the battlefield. Soldiers must also pass the Army Physical Fitness Test (APFT) according to BCT standards, which differ from regular Army standards. A minimum score of 50 percent in each tested category is required, which is a challenging requirement.

There is no Army requirement concerning physical fitness for soldiers enlisting in the Army. The only weight requirement states that they cannot be more than 60 pounds over their maximum allowed weight. If an overweight soldier enlists in the Army, he is placed on the overweight program and treated like any other soldier. In today's society, where physical fitness and total health are not highly valued or emphasized, many soldiers cannot successfully complete one push-up when they arrive at the reception station.

Soldiers who complete all the BCT requirements are awarded a weekend pass, which is the only pass given during the entire cycle. It is a motivational tool for the advanced individual training that is about to begin.

Phase IV. Light engineer training includes 13 days of demolitions and land mine warfare training. During demolitions training, soldiers learn to properly construct electric and nonelectric firing systems and to detonate demolitions. They participate in two demolitions ranges to test their proficiency in these tasks. Then they are taught the fundamentals of mine laying and mine clearing with a variety of antitank mines.



In simulated mine training, recycled tires are used in place of traditional sawdust.

Phase V. Mechanized engineer training, which lasts 10 days, consists of M60 chassis training, AVL B emplacement, and armored combat earthmover (ACE) operations. Class size is extremely important during this phase. Simply stated, the fewer soldiers in a class, the more driving time per soldier, which answers CPT Striker's question in the opening scenario.

The military occupational specialty (MOS) 12B Combat Engineer program of instruction states that the minimum, optimum, and maximum class sizes are respectively 135, 150, and 200 soldiers per company. Often, these classes are either overbooked or not filled at all. During the summer and fall, many classes have more than 250 soldiers per company because of the large number of soldiers who enter the service after high school graduation. From November to May, classes are small due to the limited number of recruits. The Engineer School tries to prevent this accordion effect, but potential recruits usually enlist in whichever service has the quickest opening (and paycheck). Competition is especially keen between the Marines and the Army, because both services have similar combat MOSs and are often recruiting the same potential enlistees.

The last three major events of AIT are the End-of-Cycle Comprehensive Test (EOCCT), the five-day field training exercise (FTX), and the APFT according to regular Army standards.

To successfully complete the EOCCT, soldiers must score a "GO" in every category. Every aspect of the 12B POI, including M9 ACE and AVL B employment, is tested. This is accomplished by using realistic simulators and training aids, which are fabricated at the local Training Support Center. They provide soldiers the opportunity to train and be tested on equipment in an indoor environment.

After the EOCCT, soldiers must complete the combat engineer FTX and APFT. These two events are conducted using the same standards as a regular modified table of

organization and equipment unit. Once soldiers successfully complete these events, normal outprocessing occurs and they graduate from OSUT.

Team Training

The training that each MOS 12B soldier receives at Fort Leonard Wood is challenging, realistic, and demanding.

The Engineer School continually reviews and adjusts the training and subjects taught to meet demands of the modern battlefield. Suggestions and input from warfighting units are requested regularly. For example, before 1995, MOS 12B soldiers received training on the Bailey bridge. However, this instruction was eliminated when the Engineer School consolidated MOSs 12B and 12F and determined that more critical tasks should be taught in the time allowed. The "demise" of the combat engineer vehicle and requests from field units caused two days of Bailey bridge training to be reinstated into OSUT.

Each year more than 3,500 combat engineers are trained at Fort Leonard Wood. The soldiers come from unique backgrounds and circumstances, but each is expected to meet the same standards. These standards could not be met without the hard work and dedication from the team of quality civilians and soldiers who train them. The caliber of the combat engineers entering the Total Army force today is a direct reflection of this team-training approach.



Captain Farrell is commander of Alpha Company, 35th Engineer Battalion (OSUT), Fort Leonard Wood, Missouri. He was previously assigned to the 44th Engineer Battalion (Mech), Camp Houze, Korea, and has served combat tours in Saudi Arabia (Operations Desert Shield and Desert Storm) and Somalia (Operation Restore Hope). CPT Farrell holds a degree in civil engineering from Virginia Military Institute.

Photographs by Jim Ray, TSC, Fort Leonard Wood.

Operation Desert Strike: An Engineer Commander's Perspective

By Lieutenant Colonel Gregory S. Kuhr

In September 1996, the National Command Authority ordered an Army brigade combat team (BCT) to deploy to Kuwait in response to Iraqi military actions against Kurdish minorities in northern Iraq. The 1st Cavalry Division's 3rd "Greywolf" BCT responded, along with its supporting 8th Engineer Battalion. The 3rd BCT already had a task force in country as part of the normal Central Command rotations, so it deployed an additional armor and infantry task force with supporting arms. This article describes the deployment from an engineer commander's perspective and highlights lessons learned during each phase of the operation.

Pegasus Strike

Now that deploying to a theater and drawing pre-positioned sets of equipment is becoming the norm for many units, commanders must develop deployment plans to adequately prepare for these missions. Since deployment readiness is the top priority for the 1st Cavalry Division, it has developed an excellent deployment standing operating procedure (SOP). Known as *Pegasus Strike*, it is continuously refined as each redeploying unit offers new lessons learned. The SOP has five subelements:

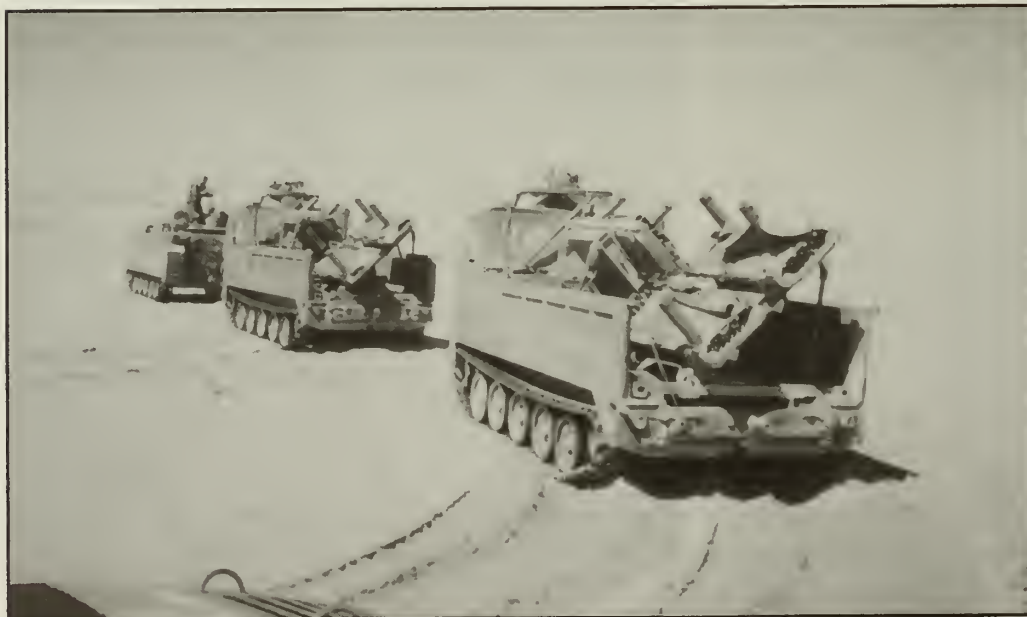
- Pegasus Point - all deployment preparations through departure from home station.
- Pegasus Landing - reception, staging, onward movement, and integration of all forces.

- Pegasus Fury - combat operations.
- Pegasus Calm - regeneration of pre-positioned equipment and transport of unit equipment and personnel to the home station.
- Pegasus Recoil - full recovery of equipment and personnel.

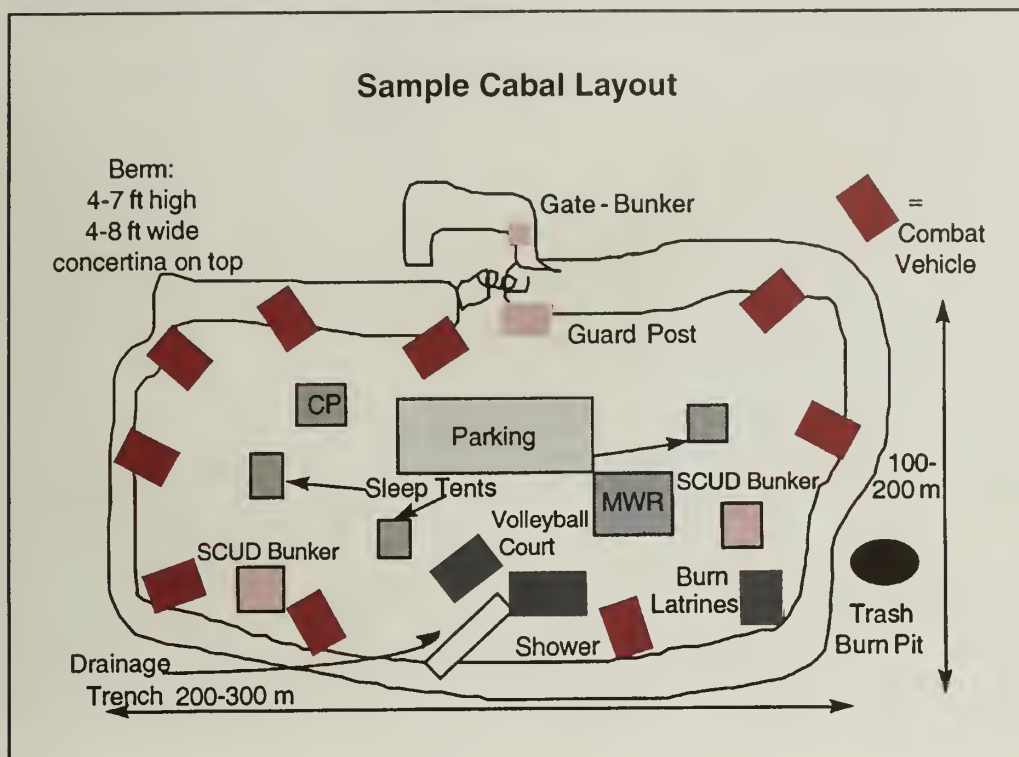
Pegasus Point. Personnel availability is an immediate concern for deploying commanders. The goal is for all units to be at 90 percent personnel strength or more. We were at 94 percent, but once the deployment criteria were established, we were 54 soldiers short of the objective. Additional soldiers were attached from the engineer brigade's other two battalions. Company commanders verified the soldiers' deployment readiness and integrated them into their units. Their families were added to the rear detachment notification rosters and family support group telephone trees.

Lesson Learned: Deploying commanders must develop a plan to integrate attached soldiers into their units. This plan must address not only soldier readiness but also inclusion of families into rear detachment notification rosters and the company family support group structure.

In the 1st Cavalry Division, commanders track deployments daily with charts (weapons qualifications, training and personnel status, and family readiness). Standards are detailed in the



The Volcano mine-laying system proved to be a significant force multiplier in a desert lacking obstacles to limit cross-country movement.



Pegasus Strike SOP. When called to deploy, a commander can immediately assess current posture, identify shortcomings, and develop a plan to attain the standard.

After establishing the deployment criteria, the rear detachment was formed from personnel identified as nondeployable. A rear detachment order addressed physical security, equipment maintenance, and property accountability.

To prevent a maintenance backlog, our home station fleet of more than 150 prime movers must be maintained during the deployment. The fleet consisted of 29 M113A2 armored personnel carriers, 12 armored vehicle-launched bridges (AVLBs), 21 armored combat earthmovers (ACEs), 29 HMMWVs, and 13 HEMMTs. The rear detachment order included instructions for exercising and maintaining the equipment on a weekly basis.

Our direct support work was transferred to a forward support battalion (FSB) that did not deploy. The engineer brigade gave the FSB a priority for the work, and it was understood that some assets would be dedicated to meet this requirement.

AR 750-1, *Maintenance Operations*, allows services to be postponed and vehicles put into administrative storage; however, our command decided to leave a maintenance NCO and a prescribed load list clerk behind to supplement four nondeployable mechanics. The rear detachment performed wheeled services, and we performed services for tracked vehicles and engineer equipment when we returned.

Lesson Learned: Ensure your rear detachment has an order or SOP that describes its duties and responsibilities, especially in the areas of physical security, equipment maintenance, and information dissemination to families.

Our family support groups were very active before deployment. Commanders ensured that all soldiers, including those attached from another battalion, were on telephone lists. Each soldier provided a strip map to his house in case of an emergency. NCOs talked to soldiers about managing bills and other affairs while they were deployed. A nondeployable senior NCO was designated the battalion's command financial specialist to assist families with financial problems.

Lesson Learned: Single soldiers residing off post frequently do not have anyone to manage their affairs during deployment. They must make arrangements for their apartment, utilities, telephone, cable, etc.

We contacted the Army War Reserve (AWR)-5 contractor, ITT Corporation, to determine what equipment could be drawn out of the AWR-5 at Camp Doha, Kuwait. Equipment not available was considered "to-accompany-troops (TAT)" equipment, which must be air-loaded. We compared equipment available from the AWR-5 with our authorized modified table of organization and equipment (MTOE) to produce an initial list of TAT equipment. This list was reduced through mission analysis and the availability of 463L pallets. After the BCT decided on a final TAT list, each company movement officer built an authorized unit equipment list in the Transportation Coordinator's Automated Command and Control Information System.

Lesson Learned: You cannot draw or ship all authorized equipment just because it is on your MTOE. Conduct a mission analysis to determine essential equipment and prioritize its shipment as TAT.



All cabals were constructed with a serpentine entrance in order to slow approaching vehicles.

Alpha Company, 8th Engineers, which had been in country since August 1996, found that dozers were essential, because the ACE lacked sufficient power to cut into hardpan soil beneath the top 1- to 2-foot layer of sand. However, dozers require an M916 truck and trailer to move between distant sites, and divisional engineer battalions have neither operators nor mechanics for dozers and M916s. Before deploying, we trained 10 ACE operators on basic dozer operations, and when we arrived in country, we drew five dozers and trained the ACE operators on the job. We also drew an M916 and an M920 truck with 40-ton lowboy trailers and used soldiers already licensed on the equipment to operate them. Our mechanics learned to troubleshoot and repair the equipment as problems arose. Now engineer battalions within the division are directed to incorporate dozer training in their training plans.

Lesson Learned: Engineer units must be versatile and able to adapt to the METT-T (mission, enemy, terrain, troops, and time available) conditions to ensure their missions are accomplished. Deployments cause units to stretch their capabilities, so leaders must be flexible in their problem-solving processes.

Pegasus Landing. The goal is for each company's pre-positioned set of equipment to be drawn within six hours of the company's arrival at Camp Doha. Major tasks during the draw include:

- The operator performs before-operation preventive maintenance checks and services on all equipment.
- The company draws weapons; supplies; and sets, kits, and outfits.
- The company commander signs for equipment on a master hand-receipt.

Home station load plans for equipment and supplies could not be used because models and quantities of some of the available equipment differed (for example, the M113A3 at Fort Hood differed from the M113A2 available in AWR-5). Some items had to be left behind for a return trip, including part of the Class III package materials and much of the Class IV barrier materials.

Lesson Learned: Home station load plans cannot always be applied to the pre-positioned fleet. To expedite the equipment draw, units should scrutinize the unit basic load for all classes of supply and make a tentative plan before the deployment.

Before initiating training, units were allowed 10 days to complete inventories, finalize hand receipts, and build cabals (see figure on page 15). A cabal is a tactical assembly area (TAA) with a 6- to 8-foot berm that defines a company's perimeter and enables it to establish a force-protection scheme (traffic flow, crew-served weapons, and perimeter security). Tents were set up, field latrines and showers emplaced, trash burn pits constructed, weapon-firing platforms and serpentine entrances built, and soldiers acclimatized to the weather.

Pegasus Fury. To prepare the force for all possible missions, an aggressive training program was initiated after the 10-day acclimatization. Units began with individual training, which included weapons qualification, common task testing, and military occupational specialty training. This evolved sequentially to squad, platoon, company, and battalion situational training exercises. The following eight-step training model was used:

1. Plan the training
2. Train/certify the leaders

3. Reconnoiter the training site
4. Issue the plan
5. Rehearse
6. Conduct the training
7. Conduct the after-action review
8. Perform retraining

The brigade commander established five priorities which were discussed daily among commanders: force protection, quality of life, safety, training, and maintenance.

Force Protection. Throughout the deployment, force protection was paramount. Several reports of threats made by terrorist organizations against U.S. soldiers in Kuwait were taken seriously due to the recent bombing of the Khobar Towers in Saudi Arabia. In the cabals, each unit maintained 25 percent security around the clock, crew-served weapons and night vision goggles were mandated, and ammunition was carried in magazines but not loaded. No single-vehicle convoys were authorized outside of the brigade's TAA unless approved by a battalion commander. The brigade's entire TAA was secured with manned checkpoints to control unauthorized access and ensure that civilian vehicles (such as water trucks) were escorted.

Lesson Learned: A strong force-protection posture serves as a deterrent for external threats.

Quality of Life. We worked hard to improve our quality of life. Lights and wooden floors in tents, hot water for showers, video players and televisions for each company, tables and benches for eating areas, sports competitions, and unit barbecues kept the soldiers involved in improving their facilities and made life in the desert bearable.

Lesson Learned: Quality of life is a morale builder and force-sustainment issue.

Safety. We emphasized safety in every activity, beginning with a risk assessment and implementation of control measures to make the risks acceptable. We conducted classes to remind soldiers of basic safety precautions. Topics included everything from operations (weapon misfires, vehicle maintenance, etc.) to personal care (preventing dehydration, field sanitation, etc.).

Lesson Learned: The key to safe training is for commanders to religiously conduct risk assessments and implement risk-management controls.

Training. The brigade commander wanted soldiers to consider this deployment the best training they had ever experienced. Weapons qualification ranges were constructed from bare desert, and the live-fire and fire-control exercises

challenged crews with an assortment of targets. All weapons were brought into the "fight" and often combined the dismounted infantry with the M1A1 Tank and the M2 Infantry Fighting Vehicle. The combined arms team participated in all aspects of the training, which included artillery impacting just forward of the friendly units, engineers firing MICLICs or blowing demolition charges while covered by maneuver forces, and smoke tracks laying down a heavy screen of covering smoke. Soldiers looked forward to getting on the range, because it was challenging and exciting.

Maintenance. Commanders ensured that proper preventive maintenance was conducted and intensively managed all pacer and combat-essential deadlining deficiencies.

Pegasus Calm. Toward the end of the deployment, we focused on regenerating the AWR-5 equipment set so it was ready for reuse in combat when we turned it in. We established a command post at Camp Doha to receive convoys from the desert, manage the limited facilities, track the regeneration process, and troubleshoot problem areas. Because limited facilities at Camp Doha forced the brigade to sequence its units through regeneration, normal brigade command and control nodes continued to operate in the field. Thus, the 8th Engineer Battalion received the mission to control regeneration operations for the brigade. We did not regenerate other units' equipment, but assigned responsibilities, set up schedules, designated facilities, communicated standards, and tracked and reported progress. The task force and company commanders were responsible for meeting the regeneration standards and timelines.

Lesson Learned: Regeneration is like any combat mission. Assigning a controlling headquarters significantly aids communication flow, adherence to standards, scheduling, and reporting.

Wheeled convoys and heavy equipment transports carrying tracked vehicles were escorted to Camp Doha's primary turn-in lot, where the regeneration process and schedule were briefed to commanders. Every option was considered to bring nonmission-capable (NMC) equipment to a fully mission-capable (FMC) status, including local repair or purchase of parts, controlled substitution between vehicles, and parts shipment from the states.

Lesson Learned: Regeneration is not just turning in equipment to the AWR-5 contractor. It is getting the fleet ready for quick reissue if an operational emergency arises. Set a goal to regenerate the fleet to the highest standard possible, then intensively manage all NMC equipment.

The 8th Engineer Battalion developed a system using a Microsoft Excel spreadsheet to track the brigade's operational readiness (OR) rate as equipment was turned in. We established a file for each company and when their OR rates were updated, the



At the Camp Doha washrack, a soldier cleans his M113 thoroughly prior to a technical inspection.

spreadsheet automatically reflected a revised OR rate for them, the battalion, and the BCT. This data allowed the brigade to focus maintenance resources on companies or equipment with problems.

Perhaps the most demanding task during regeneration was managing the life support area. Insufficient facilities at Camp Doha required that units redeploy from the desert in a sequential manner. The camp could accommodate approximately 2,200 soldiers, but there were more than 4,000 in the brigade. The battalion established a billeting plan and arranged for sufficient latrines and showers. When a company regenerated its equipment, it moved out of the billets (warehouses with beds) and into holding areas (also warehouses) until the unit departed for the airport. This movement allowed another unit to begin its regeneration process.

Lesson Learned: The life-support requirements must be closely managed to ensure that the commander's intent for mission accomplishment is met.

Pegasus Recoil. As companies completed the regeneration process, home-station equipment was prepared for shipment and soldiers were manifested for the return flight. When possible, companies from the same battalion were manifested on the same plane to facilitate the family support group reception at Fort Hood.

Back at Fort Hood, recovery was the battalion's immediate concern. Tasks to be accomplished included:

- Re-establish property accountability to first- and second-line supervisors.
- Inventory all TA-50 equipment and make appropriate adjustments.
- Recover equipment that was shipped.

- Re-establish the unit maintenance program.
- Designate compensatory time for soldiers to recover with their families.
- Ensure the unit's deployment readiness is back to standard as soon as possible.
- Assign new soldiers who arrived at Fort Hood during the deployment.
- Prepare NCO Efficiency Reports for soldiers attached to the battalion from a sister unit.

It took at least three months to get equipment back to standard and allow soldiers to fully recover. We were exempted from additional missions, or it would have taken even longer.

Lesson Learned: Allow sufficient time to fully recover after a deployment. Develop a plan of tasks to be accomplished, establish milestones, and work to meet your goals.

Conclusion

The deployment to Kuwait reinforced the 1st Cavalry Division's deployment standards and methodology. *Pegasus Strike* enabled us to think ahead and develop plans for each follow-on phase of the operation. The lessons we learned will not only contribute to further development of the division's deployment procedures but will also help other units prepare for deployments in the future.

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Letter to the Editor

The Engineer Reconnaissance Platoon: Overcoming the Lack of Engineer Reconnaissance Assets

Mr. Sayer's article (*Engineer*, August 1997, page 46) presents some interesting concepts on engineer-specific intelligence gathering. However, just down the block from the AWE's 299th Engineer Battalion, the 8th Engineer Battalion of the 3rd (Greywolf) Brigade, 1st Cavalry Division, has been practicing a variant of engineer reconnaissance for the past three years.

My battalion recognized the same need for timely engineer-specific intelligence that Mr. Sayer identified. We attacked the problem by attaching sappers from the line companies to both the task force scout platoons and the brigade combat observation lazing teams (COLTs). Typically, each line company would attach two sappers from one platoon to their task force scouts and the other platoon would attach two sappers to the brigade COLT section (12 soldiers/6 teams per BCT).

The soldiers were senior specialists or junior sergeants, and they trained with their supported element for a 9-month period, beginning with the ramp-up for a National Training Center (NTC) rotation and culminating with the NTC rotation. They conducted as much joint training as possible, ranging from daily PT to advanced scouting techniques.

These engineer augmentees painted a detailed picture for each task force and the brigade as a whole. Each sapper operated with a different scout section or COLT that covered engineer-specific named or targeted areas of interest. This typically yielded four sets of engineer eyes in each task force sector (two teams of two soldiers), and they provided detailed reports on such activities as enemy defensive preparations or breaching attempts on friendly obstacles. The sappers operating with the COLTs proved to be extremely valuable, because they were usually air assaulted to their outposts (OP) and were therefore much more survivable than their scout counterparts.

I think this is a more feasible solution to the engineer scout dilemma than Mr. Sayer's. First, it is something that each mechanized engineer battalion can do now, without having to wait years for modified table of organization and equipment (MTOE) changes. Second, although taking these soldiers "out of hide" decreases the line companies' ramp strength, this loss is minimal and is greatly outweighed by the timely and accurate intelligence that the scout-sappers generate. Third, this plan yields twice as many engineer OPs as does the proposed engineer reconnaissance platoon, increasing both their survivability and intelligence-gathering capability. Finally, this option only requires half as many soldiers and none of the specialized equipment that the reconnaissance platoon mandates. In light of today's ever-decreasing budgets and troop strengths, this augmentation plan appears to be a much more realistic option.

Captain Mark A. Gerald
C Company, 554th Engineer Battalion
Fort Leonard Wood, Missouri

Author's reply:

I appreciate your comments concerning the 8th Engineer Battalion's decision to implement a scout capability. Your experience is another example of many minds recognizing a common problem. Attaching scouts to the task force scouts

and brigade COLTs is one method I considered but ultimately rejected. There were four reasons for this rejection.

- I don't think this method is sustainable in the long term. There would be no engineer presence within the scout training plan except when a unit is preparing for deployment to the National Training Center.
- I don't think engineer skills would be maintained when engineers are attached to maneuver units.
- Attachment does not allow the engineer commander enough influence over the employment of this costly asset. The engineer companies and battalion are, in fact, taking these soldiers out of hide, and I think the battalion should retain greater command and control of them.
- As stated in my article, the level of training these soldiers receive is directly tied to their ability to survive on the battlefield. When attached to different units, there is no method to verify that their knowledge, skills, and abilities meet the requirements for combat employment.

Additionally, you state that your method provides more eyes to cover the task force area. The method I propose delivers eight engineers to each task force. As I understand your method, four soldiers from each company are provided for the reconnaissance mission, with two soldiers going to the supported maneuver task force and two going to the COLTs. Therefore, each individual scout would be task organized to separate scout and COLT teams. I have always been uncomfortable with assigning missions to elements without back-up. Your method provides six sets of eyes with the brigade COLTs (one team of two soldiers from each line company), totaling 12 sets of eyes within the brigade boundary. My method provides eight sets of eyes (soldiers) for each task force, totaling 24 sets of eyes on the brigade battlefield, with engineer scout teams assigned to the COLTs based on mission requirements and METT-T. While this method costs more in terms of manpower and equipment, I feel that the benefits of the redundancy outweighs the cost.

Finally, I believe that activating the scout platoon as depicted in my article probably is less difficult than you think. The commander can get the additional HMMWVs and radios needed to equip the platoon (probably the most difficult items to acquire) by listing those items as a commander's requirement within the battalion MTOE documentation. Possessing sufficient organic vehicles and communication assets is critical for accomplishing scout platoon missions. As you state, the teams co-located with COLTs probably would arrive at their positions by air insertion. While this method provides short-term benefits insofar as insertion is concerned, sustaining the teams after insertion becomes more difficult if they are discovered or sustain combat losses. In that scenario, any scout who is injured or who is required to evade the enemy is limited to a foot-march egress from his position. The availability of air assets to withdraw scouts is questionable at best. Duty to our soldiers requires better planning than "I hope that..." Too many times we have seen soldiers "die of wounds" or be overrun because their extraction was only cursorily planned or executed without planning. Many units at the NTC struggle to accomplish this critical mission, and very few succeed.

Again, thank you for contributing your ideas and continuing the discussion on this important topic.

Michael W. Sayer

ENGINEER COMPANY OPORDS

By Captain Joseph F. Birchmeier

Company operations orders (OPORDs) provide subordinate company leaders a clear visualization of tasks the company must accomplish for an upcoming operation and describe how the commander expects to accomplish them. Appendix B of FM 5-71-2, *Armored Task-Force Engineer Combat Operations*, includes a good example of a company OPORD. However, the OPORDs prepared by many company commanders who train at the National Training Center (NTC) do not include details their units need to be successful during the mission. This article focuses on problem areas that I have observed in company OPORDs.

Planning the OPORD Briefing

Before the OPORD briefing, the commander must decide—

- Who will attend.
- When it will be given in relation to the task force (TF) OPORD briefing.
- What briefing products will be used.
- What products will be issued to the platoons.

Attendees. My recommendation is that the first sergeant, platoon sergeants, platoon leaders, and a company command post (CP) representative attend the company OPORD. For defensive operations, the NCO providing engineer expertise at the Class IV/V point also should attend.

The platoon sergeants provide each platoon another set of ears at the OPORD to ensure that all information is captured. Their presence gives the commander immediate access to some of the most experienced personnel in his unit to quickly spot problems with the company's plan. They will also hear paragraph 4, which the platoon leaders will expect them to execute.

A representative from the company CP also should attend the OPORD briefing, so he can take any changes back to the CP.

Briefing Time. I believe the commander should issue the company OPORD before the TF OPORD to capitalize on the company's ability to parallel plan with the TF. This sequence allows platoon leaders to link up with the supported company team immediately after the TF OPORD to help develop the company team OPORD. If the platoons remain under the engineer commander's control during the upcoming mission, platoon leaders can continue their troop-leading procedures.

Briefing Products. At a minimum, a commander should use the modified combined obstacle overlay (MCOO), the situation template (SITEMP), the fire support overlay, TF maneuver graphics, and the obstacle overlay, if applicable, during his OPORD. The combat service support (CSS) overlay should also be used, if available.

The commander should provide a hard copy of the company OPORD to platoon leaders, or at a minimum, he should provide a copy of the OPORD form so they can fill in the blanks. The commander should also provide the SITEMP (if not provided with one of the company's warning orders), the fire support and CSS overlays, maneuver graphics, pertinent terrain products (such as Terrabase), and the obstacle overlay, if applicable.

Before beginning an OPORD, commanders should require that platoon leaders post the maneuver graphics on their maps and allow them to make notes on the overlay. This information will help them understand the OPORD. The commander may also require that platoon leaders provide the current status of personnel, equipment, and supplies (to include demolitions, small-arms Class V, and marking materials) before the OPORD. The status reports provide an early warning of potential "show stoppers" that may need immediate attention or require changes to his plan. Information that the commander requires from platoon leaders should be in the unit SOP. The commander should issue his OPORD from a location that helps platoon leaders visualize the upcoming mission. It is not always possible to issue an OPORD on terrain overlooking the objective; however, if terrain leading to a key pass through which the unit will maneuver is visible, the view will greatly assist platoon leaders.

Paragraph 1

This paragraph often lacks sufficient detail and contains several problem areas.

First, many commanders do not discuss the impact of terrain on breaching operations. For example, based on an analysis of the terrain, they should indicate where the use of mine-clearing blades will be restricted because the soil is too rocky or undulating. Platoon leaders must understand this information, especially if they will be task organized to a company team, so they can explain it to the company team commander during OPORD development. The MCOO can greatly assist in the platoon leader's visualization of the terrain.

Second, commanders rarely provide details about the enemy other than his composition, disposition, and strength. They should brief all of the enemy's combat multipliers, their purpose, and where they expect the multipliers to be employed.

The NTC teaches seven forms of enemy contact. If all of them are briefed at the company OPORD, we have gone a long way toward discussing the enemy. The forms of contact are—

- Visual (if divisional/regimental reconnaissance is in sector and where the division reconnaissance teams will be)
- Direct fires (where we expect to come within range of the antitank systems, T-80, BMP, etc.)
- Indirect fires (when we expect to enter indirect-fire range of the enemy's various rocket and cannon systems)
- Air (both fixed- and rotary-wing aircraft) (where and when we expect them to attack)
- Nuclear, biological, and chemical (NBC) agents (where and when we expect the enemy to employ nonpersistent and persistent agents)
- Obstacles (what we expect the composition and depth of the obstacle(s) to be; the type of mines we expect to be in the minefields; where we expect scatterable mines—both artillery delivered and by the UMZ—and the mobile obstacle detachment to be used)
- Electronic warfare (if and when we expect the enemy to jam our communications during operations)

The commander should ensure that platoon leaders understand the mission of the remainder of the engineer battalion because engineers often are shifted from one TF to another as the battle progresses, especially during offensive operations. Similarly, the company CP should ensure that consolidated brigade graphics are available to facilitate movement to another TF zone or sector. To prevent fratricide, the commander should also inform platoon leaders of obstacles emplaced or to be emplaced by sister units. This includes the Volcano and ADAM/RAAM (area denial artillery munition/remote antiarmor mine) obstacles.

Change 1 to FM 5-71-2 moves the Scheme of Engineer Operations (SOEO) from paragraph 3.a. to paragraph 1.b. in the OPORD format (see *Engineer*, April 1997, "Change 1 to FM 5-71-2/3"). My observation is that the commander often fails to develop an SOEO. FM 5-71-2 provides outstanding examples of how to develop one. The commander should brief the SOEO as discussed in FM 5-71-2, because it explains what the company expects to accomplish in a well-organized, easily understood format. Each platoon leader must understand the company's perspective on the operation

before he focuses on his platoon's piece of the pie. Just as a company may be shifted to an adjacent TF, a platoon may have to complete tasks initially assigned to another platoon.

Paragraph 2

This paragraph normally consists of a generic sentence. For example, "D Company will provide mobility/countermobility support to the TF to support the TF's attack." The paragraph should describe tasks the platoons must accomplish for the company to be successful. FM 5-71-2 provides excellent examples.

Paragraph 3

Change 1 to FM 5-71-2 incorporates a "Concept of Operation" paragraph into paragraph 3 of the OPORD. This paragraph allows a commander to explain how engineers under his control will accomplish their assigned tasks. The paragraph is especially useful for a breach force commander during an offensive operation.

A problem with paragraph 3 is that commanders fail to develop detailed timelines that platoon leaders can refer to so they know when tasks are to be performed. Examples include the "no later than" time to have an obstacle constructed to support breach rehearsals or when the commander expects 1st platoon to have obstacle group A1A emplaced. Timelines should be as detailed as possible and include the times scheduled for TF rehearsals, logistical packages (LOGPACs), and precombat inspections (PCIs).

Commanders must provide as much detail as possible for all activities. For example, state where the obstacle for the breach rehearsal will be constructed and how many obstacles (and what types) 1st platoon will emplace in obstacle group A1A. (Details will be refined by the platoon leader on the ground.) State where the commander's PCIs will be conducted and what will be inspected.

Finally, although intent graphics are supposed to describe the effect, target, and relative location of the obstacle group in the defense, I recommend that commanders define the target for platoon leaders (perhaps by placing the obstacle overlay on the SITEMP). Additionally, I believe commanders should provide platoon leaders a proposed design of the obstacle group.

Paragraph 4

Most successful units integrate the first sergeant into the development of the CSS plan and brief this plan at the OPORD. Paragraph 4 should include the following—

- How platoons will be logistically supported if they are task organized to another unit.

(Continued on page 24)



Live Fire on a Multipurpose Range Complex

By Captain Christopher R. Felchlin

In July 1996, the 1249th Engineer Battalion at Salem, Oregon, became the first engineer unit since 1987 to conduct a live-fire exercise on the Multipurpose Range Complex (MPRC) at Yakima Training Center in Washington.

The concept was born through the efforts of the 3rd Engineer Training Battalion (ETB), 2d Regional Training Brigade (RTB), at Fort Lewis, Washington. The 2d RTB was formed in 1994 as a result of a congressional mandate, the Ground Force Readiness Enhancement Program. This program governs the conduct of evaluated platoon lane training for high-priority National Guard units, with top priority given to units designated as enhanced brigades or force support package units.

Planning

In November 1995, the 3rd ETB worked with the 1249th Engineer Battalion to plan the 1249th's two-week annual training (AT) for 1996. The training battalion includes three company teams—each with an engineer captain, a sergeant first class, and three staff sergeants—and a headquarters section. These teams evaluated the 1249th's company and platoon operations for the entire training period.

B Company, 3rd ETB, developed the MPRC live-fire exercise as part of the overall AT plan. The company produced tactical orders for the companies and platoons participating in the live-fire exercise and projected the Class IV and Class V supplies needed during each phase.

Conducting tank and Bradley gunnery is commonplace on the MPRC, but an engineer unit using the facility for training was a new concept. When briefed on the concept, the RTB and the 1249th commanders recognized the excellent training opportunity the exercise presented and the retention and recruiting possibilities it held for the battalion.

The ETB scheduled the exercise toward the end of the training period so the soldiers would have time to perfect their tasks. The lane focused on three mission training plan tasks: Troop-Leading Procedures, Conduct an In-Stride Breach, and Breach Obstacles. Another critical factor for success was to certify the platoons in both demolitions and M2 crew-served weapons before they arrived on the MPRC. The unit accomplished this during the first week of training.

The Scenario

The plan, which was finalized after several reconns to Yakima Training Center and brief backs, included a six-part scenario. In this scenario, an engineer platoon



Soldiers from the 1249th A Company start a minefield breach.

supported an armor company team as the lead element of a task force attack against a motorized rifle company (-). The ETB company observer/controller (OC) (an engineer captain), role-played the task force commander and the armor company team commander. The remainder of the ETB company OCs were safety personnel and rode in the back of the squad armored personnel carriers going downrange. Each platoon OC (a staff sergeant) rode with the platoon leader and evaluated his actions while executing the lane. Targetry on the MPRC was set up to accommodate M113A3s with M2s. Gunners engaged crew-served targets at positions from 600 to 1,800 meters, and small-arms personnel targets were engaged from 50 to 1,100 meters.

Under the platoon leader's control, three squads simultaneously proceeded down individual lanes. The platoon encountered two obstacles along the route to the objective: a wire obstacle overwatched by a combat security outpost and a 120-meter, surface-laid minefield with a concertina fence. The platoon moved through the obstacles, consolidated on the objective, and prepared for a counterattack. After completing the counterattack portion, a dismounted live fire, the platoon moved forward on order and conducted a MICLIC breach of a minefield. At this point the lane ended and the platoon returned to the staging area for shakedown and an after-action review (AAR).

The After-Action Review

When the first platoon completed the lane and moved to the AAR, the next platoon began its run down the lane. B Company timed the training schedule so that each platoon moved through the entire scenario in one day. This included two dry runs and a live-fire exercise,

along with repairing the lane and policing all marking and breaching equipment left on the lane. Scheduling was met by moving a repair team one phase line behind the platoon conducting the live-fire exercise. The technique maximized time and allowed the follow-on platoon to start within minutes of the platoon returning from the lane.

Each AAR was based on mission training plan tasks and was an in-depth analysis of what happened, how it happened, and what could be done to improve the next exercise. The platoon OC facilitated the AAR and kept the platoon on track with leading questions that allowed soldiers to discuss their perceptions of strong and weak areas. The platoon received a video and photographs showing their performance while conducting the lane and the AAR to use later as training tools.

Lessons Learned

When planning an undertaking as complex as this live-fire exercise, prior planning may prevent mishaps that have mushrooming effects.

- Push logistics to the site and prepackage items so the platoons can make final preparations.
- Deliver Class V supplies (including the MICLIC trailer, rocket, and box) at least 24 hours before the event so platoons can conduct precombat rehearsals.
- Complete weapons qualifications for soldiers before they arrive for annual training.
- Set aside one day (per company) at AT to fire the mounted M2 at both stationary and moving targets. If the MICLIC is to be used, preventive maintenance checks and services and battle drills must be routine. The MICLIC is a key piece of equipment that is frequently

neglected until needed in the heat of battle. OCs at the combat training centers have found that the MICLIC has approximately a 50-percent success rate during actual firing, and the operational rate is even lower.

- Maintain sufficient lane-marking equipment to train three or more continuous breaches. Each mechanized engineer squad must be able to breach and mark its own lane.

The Rewards

A live-fire exercise on an MPRC provides a sense of accomplishment because the event allows all organic systems to fire. The 1249th's annual training was conducted with no accidents or safety violations and at combat speed. The platoons ran the lane in less than two hours, and obstacle breaching was completed (breached and marked) on an average of 7 minutes and 15 minutes, respectively. Smoke and pyrotechnics were used extensively throughout the exercise.

The training was extremely challenging and rewarding, and most of the soldiers thought it was one of the highlights of their AT. It was the most realistic training the unit had conducted and greatly benefited combat readiness. The 1249th took home another valuable asset that will undoubtedly contribute to its overall improvement. Excited, motivated soldiers went back to Oregon with a film filled with realistic training. Both the film and lessons learned will assist the command throughout the next year with retention and re-enlistment.

The 1249th Engineer Battalion plans to make the live-fire exercise the apex of the unit's annual training. The 3rd ETB and the 1249th commanders and staff are proving the benefits of the Ground Force Readiness Enhancement Program with continued high quality, challenging training.

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(Continued from page 21)

- Details on when, where, and what type of LOGPAC the unit will use for the operation.
- Details on what type of mine resupply method will be used in the defense; what assets will be used to move Class IV/V supplies around the battlefield; if applicable, when mine dumps will be activated and closed; and how much material has been allocated to support each obstacle group.
- Adjustments to mine resupply methods throughout the operation. For example, use the tailgate method initially to upload trailers and begin the push of materials. Then transition to service station resupply once obstacle construction has begun and mine dumps are established. Revert to the tailgate method as the enemy attack nears to prevent mines from being left on the battlefield.
- A detailed casualty evacuation (CASEVAC) plan for the company—specifically, who will control the CASEVAC, which vehicles and radio net will be used, and whether casualty collection points or some other method will be used.
- A plan to evacuate vehicles off the battlefield.
- Reload plans for the MICLIC and/or Volcano. Consider adding internal company graphics to the maneuver graphics to facilitate these plans.

Paragraph 5

Paragraph 5 is normally not a problem. However, I recommend that commanders require platoon leaders to provide "jump" plans for company teams they may be attached to so communications with the platoon is maintained throughout the mission.

For the most part, commanders do not conduct safety and fratricide risk assessments or brief them and their control measures to subordinate leaders. Assessments should be well-planned and should identify specific risks to soldiers during this operation and how leaders can reduce those risks.

Summary

When stress and fatigue set in, an effective OPORD can prevent confusion on the battlefield. Commanders increase their ability to effectively communicate if they use every training event as an opportunity to give OPORDs to subordinates. An organized and detailed OPORD briefing will help ensure successful combat operations.

Captain Birchmeier is a doctrine writer in the Department of Training and Doctrine Development, U.S. Army Engineer School. He previously served on the Sidewinder 12 Team, National Training Center, Fort Irwin, California. CPT Birchmeier is a graduate of the U.S. Military Academy.

EXPEDIENT COLD-WEATHER CONCRETING

By Charles Korhonen

Imagine for a moment that you are the engineer officer or NCO in charge of a project requiring that you pour concrete—and the temperature falls below 40 degrees Fahrenheit (F). This may not sound like a big deal, but Army manuals such as FM 5-742, *Concrete and Masonry*, and industry standards direct that fresh concrete should not be cooled below 40 F after emplacement. Therefore, some form of thermal protection must be used during cold weather or your project may come to a screeching halt. If you don't have the luxury of falling behind schedule and the project budget is tight, what do you do? Fortunately, the Army's Cold Regions Research and Engineering Laboratory (CRREL) is working on a solution called *antifreeze admixtures*. Read on to learn how you soon may be able to emplace concrete at temperatures as low as 15 F or lower.

The Technical Challenge

The simplest way to protect concrete from the cold is with insulation. But when the outdoor temperature dips below 40 F, concrete usually must be protected by heated enclosures, which are resource intensive (labor, time, equipment, and budget). Under battlefield conditions or in emergency situations where concrete must be placed regardless of the temperature, engineers may not have any thermal protection, let alone a heated enclosure. If concrete must be placed unprotected in the cold, it may freeze. If it does, the results can be disastrous.

When the water in fresh concrete freezes, the ice—which takes up

roughly 9 percent more volume than water—can generate disruptive pressures that create microcracks in the concrete. Later, when the ice melts, the damage done by freezing can cut the strength of concrete in half (Figure 1).

Another interesting effect of cold weather on concrete is that it gains

strength more slowly, which is not a problem if there is time to cure it a bit longer. Under the right conditions, it may become stronger than concrete cured in warm weather. Figure 1 illustrates this potentially positive effect. During the first month, the strength of concrete cured at 40 F, the lowest tem-

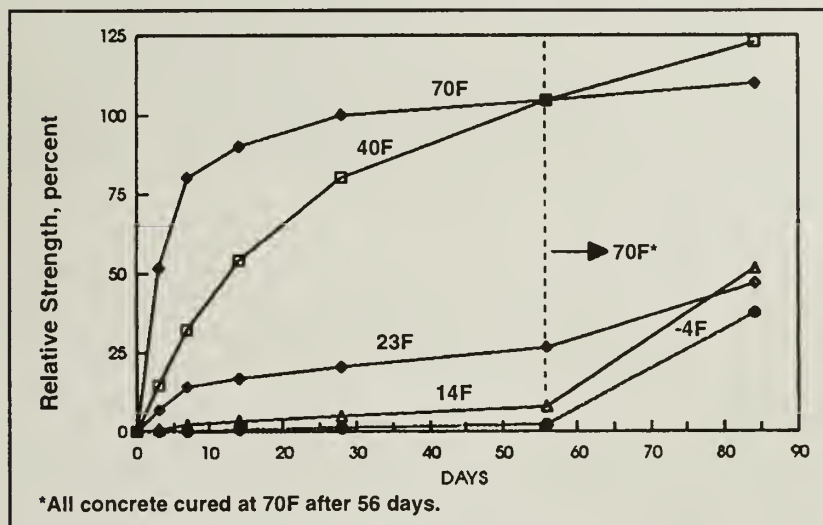


Figure 1. Effect of temperature on normal concrete.

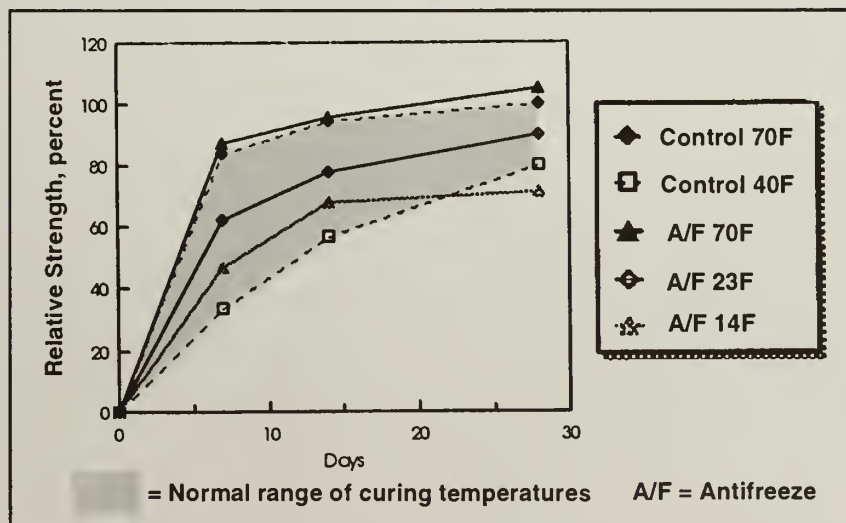


Figure 2. Results for one antifreeze chemical tested.

The following excerpt is from guidance developed for winter concreting operations in Bosnia.

A User's Guide to Antifreeze Admixtures

Description

An antifreeze admixture is a chemical compound that depresses the freezing point of water and accelerates the hydration rate of cement at temperatures below 32 F. Chemicals used in the present formulation are sodium nitrate and sodium sulfate. Available in dry form, they are dissolved in water before being mixed with other concrete ingredients.

Preparing the Chemicals

Weigh a quantity of water sufficient for one batch of concrete. Slowly stir in and dissolve a quantity of sodium nitrate equal to the weight of 6 percent of the cement required for one batch of concrete. Slowly add a quantity of sodium sulfate equal to the weight of 2 percent of the cement required for one batch of concrete.

Mixing Procedures

Follow standard mixing procedures. Add coarse aggregate and some mixing water. Start the mixer, add fine aggregate, cement, and the remainder of the water while the mixer is turning. Mix for several minutes until the mixture is thoroughly blended. (The mix water contains the dissolved antifreeze chemicals.)

Dosage

Use the following quantities per 611 pounds per cubic yard of portland cement.

sodium nitrate 36.6 pounds
sodium sulfate 12.2 pounds

Performance

Admixture Dosage by cement weight percent	Temperature (internal) of concrete degrees Fahrenheit	Compressive Strength ¹ Relative to 28 days, at 70 degrees Fahrenheit			
		percent			
		7 day	14 day	28 day	56 day ²
8	23	60 ³	75	85	100
8	14	50	65	75	100

¹The relative strengths shown are based on a limited number of laboratory tests, so field results may vary from those shown.

²Cured an additional 28 days at room temperature.

³The strength of concrete cured 7 days at 23 F is 60 percent of the strength of the control concrete cured 28 days. Thus, if the control mixture has a 28-day strength of 5,000 pounds per square inch, the 7-day strength of the 23 F mixture is 3,000 pounds per square inch.

perature allowed by FM 5-742, is less than that of concrete cured at 70 F. However, the concrete eventually becomes stronger than concrete cured at 70 F. Although cold weather often is the best time for making good, durable concrete, too much cold can be devastating.

The Solution

Developing an admixture capable of allowing concrete to gain strength at below-freezing temperatures has long been a goal of builders in the north. As early as the 1950s, the Soviet Union used ordinary salt when pouring concrete in the winter. Though corrosion was later found to be a major drawback, the use of salt as a freeze-point depressant proved that chemicals can protect concrete from freezing. Lingering concerns about the long-term effects of any antifreeze chemical on concrete discouraged their widespread use, despite the existence of chemicals that are compatible with concrete. FM 5-742 states, "...do not try to lower the freezing point of concrete with accelerators (antifreeze compounds or similar products), because the large quantities required seriously affect compressive strength and other concrete properties."

We now have evidence to ease some concerns about possible harm to concrete. Data from almost two years of laboratory and field testing with private industry (concluded in 1996) show that certain chemicals can be added to concrete to allow it to gain strength at below-freezing temperatures without detrimental side effects. Unfortunately, these findings have not resulted in commercial products to date, so military engineers still lack an off-the-shelf answer to cold-weather concreting.

To fill this gap, CRREL is using experience gained from working with private industry to create expedient admixtures for the military. Their goal is to develop guidance that will enable military engineers to formulate their

own antifreeze admixture from chemicals likely to be found in a cold-region theater of operation. The search for candidate chemicals is not limited to those that are benign to the long-term performance of concrete. Chemicals that allow concrete to remain structurally viable for as little as 6 months also will be considered. The product of this effort will be a "How To Do" pamphlet, which will detail mixing procedures, mixture proportions, chemical dosages, concrete strength estimates, and handling advisories. It will be followed by an update to Army manuals.

Figure 2 presents one of CRREL's findings. It shows that this particular admixture promotes a strength gain at 14 F that compares to that of normal concrete cured at 40 F. What's more, preliminary findings (not shown) suggest that concrete made with this admixture may be unaffected by temperatures as low as minus 4 F. Although it gains little usable strength at this low temperature, concrete seems to recover its full compressive strength when thawed.

The main drawback to this chemical is that it contains an alkali that may adversely affect the long-term durability of concrete. It causes certain siliceous aggregates to swell and crack the concrete. However, even in very high dosages, which CRREL does not recommend, the first cracking probably would not occur for 5 to 10 years. Concrete so affected probably would last many more years before its strength was greatly compromised. Since the only concern is for long-term applications, the chemical in Figure 2 was recommended as an antifreeze admixture for expedient cold-weather concreting in Bosnia (see user's guide, page 26).

Conclusions

Normal concrete cannot be exposed to freezing weather without some form of thermal protection, which places serious constraints on the use of concrete in cold-region theaters of operation. An alternative approach to cold-weather concret-

ing is under development. When completed, it will allow military engineers to place fresh concrete for short-term applications at below-freezing temperatures without the need for heat. Following this 2-year study, longer-term topics aimed at providing military engineers with enhanced winter construction capabilities will be addressed.

For more information about cold-weather concrete operations or to see other cold-weather construction practices developed, contact Mr. Korhonen at the U. S. Army Cold Regions Research and Engineering Laboratory, 72 Lyme Road, Hanover, New Hampshire 03755; telephone, (603) 646-4438; fax, (603) 646-4640; e-mail, korhonen@crrel.usace.army.mil. 

Mr. Korhonen is a research civil engineer at CRREL, dealing with maintenance and rehabilitation issues of military facilities in cold regions. He holds a master's degree in arctic engineering from the University of Alaska and is a doctoral candidate at Purdue University.

Army Division Advanced Warfighting Experiment

By Vern Lowrey

Six senior military evaluators from the U.S. Army Engineer School's Maneuver Support Battle Lab participated in the Army Division Advanced Warfighting Experiment (DAWE) at Fort Hood, Texas, 5-13 November 1997. The DAWE was a key event in Force XXI warfighting experimentation. Results of the DAWE directly impact the heavy division design decision, which is expected in February 1998.

The 4th Infantry Division conducted the exercise using the conservative heavy division design force structure. This design has three combat engineer battalions located in the division troops but no engineer brigade headquarters or commander. A 24-person engineer planning and operations staff is located at the division level.

In addition to the new force structure, several new engineer systems were included in the experiment. The three systems tested in each maneuver brigade and division tactical operations center were the Engineer-Obstacle Planner System/Tactical Engineer Command and Control System (E-OPS/TECCS), Digital Topographic Support System-Mobile (DTSS-M), and the Raptor Intelligent Combat Outpost. New systems simulated were the Grizzly, the Wolverine, the Heavy Dry Support Bridge, the Airborne Standoff Minefield Detection System (ASTAMIDS), the Deuce, and

the multirole bridge company. These systems directly support the Force XXI objectives of gaining information dominance and conducting dominant maneuver.

The following key issues are being evaluated as a result of the DAWE:

- Operational and tactical impacts on the removal of the engineer brigade headquarters for the experiment.
- Operational and tactical implications of an engineer force structure that includes a mix of Active, Reserve, and National Guard forces.
- Impact of the combat service support redesign on engineer operations and logistical support to divisional and echelon-above-division (EAD) engineers.
- Impact of changing engineer capabilities for line-of-communication and main-supply-route missions throughout the division battlespace.
- Impact of digital terrain data management on the maneuver commander's visualization of the battlespace.
- Impact of EAD engineers integrating into a digitized environment with possible incompatible communication systems.

The DAWE has given us a view of the future of our Army. We have a long way to go, but there are new and exciting implications for mobility and survivability systems as well as for other operating systems.

Vern Lowrey is technical director, Maneuver Support Battle Lab, Fort Leonard Wood.

Engineer Qualification Tables: A New Training Methodology

By Second Lieutenant Patrick O. Corr

In March 1997, the 10th Engineer Battalion at Fort Stewart, Georgia, conducted its annual Skybridge Focus field training exercise in preparation for deployment to the National Training Center. During this exercise, squads were qualified using Table VIII from the battalion's newly developed Engineer Qualification Tables (EQTs).¹ Engineer equipment crew certification was integrated into the EQT sapper training. This was the first time the unit used this qualification method, and we saw dramatically improved results.

Inspired by the success of armor and infantry gunnery tables (and previous combat engineer vehicle [CEV] gunnery tables) and the need for an organized method of sapper qualification, the 3rd Infantry Division Engineer Brigade introduced EQTs to the brigade's engineer battalions. These tables link existing programs such as the MTP, marksmanship training, and engineer battle drills into a sequential battle-focused qualification process. They build from individual tables through platoon live-fire tables and roughly correspond to armor and infantry gunnery tables.

The proficiency of squads and platoons was previously tested through exercise evaluations (EXEVALs) based on fragments of the mission training plan (MTP) and local drills. However, these EXEVALs were not well standardized or systematically resourced, tasks were not arranged or tested in an ascending degree of complexity, and individual tasks were not specifically grouped to be practiced before squad or platoon tasks. No program exists to justify a standard package of resources that can be accurately projected through the Standards-in-Training Commission (STRAC). Adequate amounts of ammunition and demolitions are rare, and most posts do not have areas large enough for demolitions training. There is no priority for logistical requirements for training engineers, because we do not have a system that speaks the same language to our maneuver brothers. These conditions do not facilitate quality engineer training. All this changes when individual units are given priority, because they train under a system of qualification tables recognized by installation and unit commanders.



During Exercise Skybridge Focus, soldiers are rated on how quickly they successfully reduce a surface-laid minefield.



Combat engineers construct a wire obstacle.

Execution of EQT VIII

Exercise Skybridge Focus was the test bed for EQT VIII, and it provided significant evidence of EQT success. Eighteen squads from six line platoons were qualified on EQT VIII tasks. Four of those squads received 100 percent first-time GOs and were rated as "Killer Squads."

Sapper squads and assault and obstacle crews performed mobility, countermobility, or survivability tasks each day. The training was set up using scenario-based lanes and grouped into drills based on mobility, countermobility, and survivability. Each line company set up and evaluated a portion of the lanes based on the EQT and crew certification tasks.

Throughout the week, mobility drills were run and evaluated by A Company. Individual lanes were planned by the company, and internal leadership served as observer/controllers for each lane. It is important that NCOs provide input concerning lane planning, because their squads are being trained and evaluated. The mobility lane included a combination of squad drills and crew certification tasks. The tasks were not part of the EQT but complemented the sapper lane training well. They provided an excellent opportunity for the battalion to certify all armored combat earthmover (ACE), armored vehicle-launched bridge (AVLB), small emplacement (SEE), and Volcano operators. Each drill lasted approximately three hours. The following paragraphs briefly describe each drill and certification task :

Mobility Table VIII Drills

- ❑ **Clear a footpath with a bangalore torpedo.** Since this drill requires live demolitions, a three-hour dry

rehearsal was conducted. Each squad was first certified on inert demolitions.

- ❑ **Breach a surface-laid minefield, dismounted.** Squads were rated on speed and the successful completion of a dismounted breach of a surface-laid minefield while using live demolitions. This drill was performed on the same lane as the bangalore breach to simulate a complex obstacle and on terrain where such obstacles might be emplaced (not the demolitions range).
- ❑ **Conduct minesweep operations.** Minesweeping is a lost art, and this drill proved to be extremely challenging. We found that doctrinal rates for minesweeping are twice as fast as those normally achieved on the ground. Four to five hours were required to properly execute this drill.

Mobility Crew Certification Tasks

- ❑ **Proof a vehicle lane using an ACE.** This task requires significant operator training before certification because herringbone operations are a challenge for operators.
- ❑ **Reduce an antitank ditch.** This lane was very successful. We used the same ACEs to reconstruct the antitank ditch after they reduced it. A maintenance team should be kept on site when digging with ACEs, because one downed ACE can bottleneck the crew certification lane.
- ❑ **Defeat a wire obstacle.** We seldom use this task at the NTC, but it can be very effective and has minimal impact on the ACE.

B Company executed the countermobility lane. They provided evaluators and did the planning for four EQT drills

and three crew certification tasks. Each lane lasted three hours except for the antitank ditch lane, which lasted six hours.

Countermobility Table VIII Drills

- ❑ **Construct a wire obstacle.** This is an old staple for combat engineers. Every squad qualified at night using double the normal time. Nearly all of the squads received first-time GOs.
- ❑ **Create a hasty road crater.** Live demolitions were used on this lane. To add realism, the operation was conducted on a tank trail, not a range. Because a nonstandard area was used for demolitions, all entries to the area were blocked. Additionally, the lane officer-in-charge coordinated use of an ACE to fill the craters after each squad went through. A dry-fire rehearsal of this drill was conducted before it was executed with live demolitions. This helped ensure safety and squad success since not enough demolitions were available to retrain with live demolitions.
- ❑ **Emplace a row in a deliberate minefield.** Inert mines were used during this task. This is an easy drill to set up, and the squads performed it proficiently.
- ❑ **Emplace a nuisance minefield with the modular pack mine system (MOPMS).** The 10th Engineer Battalion used the MOPMS for this drill since it is a critical task that supports our mission essential task list. This task is very technical and required the most retraining. It was most responsible for squads falling short of obtaining "Killer Squad" status.

Countermobility Crew Certification Tasks

- ❑ **Emplace and mark a Volcano minefield.** Our crews were certified, but we encountered problems with maintaining the Volcano. Operators must perform preventive maintenance checks and services on the racks as well as the vehicle to help prevent the Volcano from going down during certification.
- ❑ **Construct a tank ditch.** All ACE operators were certified. A lot of digging is involved, which presents ideal conditions for an ACE

10th Engineer Battalion Engineer Qualification Table Program

EQT training is conducted in three phases: basic (individual), intermediate (squad), and advanced (platoon).

The *basic* phase, Tables I-IV, establishes the lowest level of sapper skills and culminates with weapons, mines, and demolitions qualifications. These are stand-alone events involving sapper teams or individual soldiers. This training is normally executed during "sergeants' time," range weeks, demolition ranges, and other unit training.

The *intermediate* phase, Tables V-VIII, builds on the skills developed during the basic phase. This phase develops team and squad skills and culminates with a battle drill certification and live-fire qualification course.

The *advanced* phase, Tables IX-XII, develops platoon coordination and execution. It culminates with a platoon qualification course for both offensive and defensive scenarios.

The following tables are included in the EQT Program:

Table I - Leader Certification. 12B NCOs and line platoon leaders are certified in mines and demolitions within 90 days of their assignment to the unit.

Table II - Individual and Crew Certification (Inert). Squad leaders conduct individual training on mines and demolitions using inert training devices. Individuals must be certified before Table IV training is conducted.

Table III - Individual and Crew Weapons Qualification (Live). Squad leaders conduct preliminary marksmanship instruction for individual and crew-served weapons, and squad members qualify with their assigned weapon.

Table IV - Mine and Demolitions Qualification (Live). Companies certify squads on mine and demolitions training using live mines and demolitions.

Table V - Squad Battle Drill Training. Squads train on seven drills: construct a wire entanglement; create a hasty crater obstacle with explosives; emplace a row in a minefield; emplace a point minefield; breach a surface-laid minefield, dismounted; clear a footpath with a bangalore torpedo; and conduct minesweep operations.

Table VI - Squad Battle Drill Certification. The platoon leader evaluates and certifies squads on the seven sapper drills based on Table VIII conditions without live ammunition. Squads will not execute Table VII until they are certified by the platoon leader.

Table VII - Squad Battle Drill Qualification Course (Dry Run). Squads execute sapper battle drills in a tactical scenario using blank ammunition and realistic demolition-effects simulators. Tasks are performed on terrain similar to the training area used for live certification.

Table VIII - Squad Battle Drill Qualification Course (Live). Squads execute sapper battle drills in a tactical scenario using live ammunition and demolitions and inert mines. The company commander evaluates and certifies squads. Additionally, all ACE, AVLB, SEE, and Volcano crews are certified on their equipment.

Table IX - Platoon Battle Drill Training. The platoon trains on six tasks: conduct an in-stride breach with a MICLIC, conduct an in-stride breach dismounted, establish a mine dump, emplace a tactical minefield, emplace wire entanglements, and site and mark a Volcano minefield.

Table X - Platoon Drill Certification. The company commander evaluates and certifies the platoon on six platoon drills without live ammunition or live demolitions.

Table XI - Platoon Drill Qualification Course (Dry Run). The platoon executes the drills in a tactical scenario using blank ammunition and demolition-effects simulators. Tasks are performed on terrain similar to the training area used for live certification.

Table XII - Platoon Drill Qualification Course (Live). The platoon executes the drills in a tactical scenario using blank ammunition, live demolitions, and inert mines. The battalion commander evaluates and certifies the platoon.



The 10th Engineer sappers complete the breach.

breakdown. Make sure a maintenance team is on site to repair ACEs.

- ❑ **Construct a tank berm.** This lane is very intensive and requires a maintenance team on site.

Survivability Table VIII Drills

The survivability lane did not have any Table VIII drills but concentrated on key tasks that directly supported crew certification—a combination of survivability and force protection tasks. D Company planned and executed this lane. All the company nuclear, biological, chemical (NBC) NCOs were attached to D Company, headed by the battalion NBC NCO, to run a complex NBC lane. The line squads executed two lanes lasting two hours each. The first lane was centered on bivouac force protection, while the second lane was an NBC lane. The crew certification lanes lasted four hours each.

Survivability Crew Certification Tasks

- ❑ **Construct a fighting position for the M1 with an ACE.** Again, a maintenance team must be on site to conduct repairs.
- ❑ **Construct a modified two-tier M2 position with an ACE.** Due to the similarity to Lane 1, the same site and observer/controller were used.
- ❑ **Construct crew-served fighting positions with the SEE.** This lane was successful, and all operators were certified.

Sapper Drills

These drills are not a part of Table VIII but provide direct support.

- ❑ **Conduct NBC skills procedures.** This training is necessary for every soldier. Squads conducted dismounted

movement and performed unmasking procedures with and without an M256 kit. Each squad faced several different NBC scenarios with realistic effects. Most soldiers said they wanted more NBC training conducted this way.

- ❑ **Perform bivouac procedures.** During this lane, each squad performed multiple tasks ranging from practicing camouflage techniques to constructing battle positions, occupying a squad sector and employing an M8 alarm, setting up wire communications, and preparing range cards and sector sketches.

Training Success

Skybridge Focus proved the effectiveness of EQT VIII. The EQTs are an excellent way to efficiently measure sappers' proficiency and resource training. During the quarterly training brief before Skybridge Focus, the 3rd Infantry Division commander saw what the resource requirements were for the EQT program and that the normal engineer Standards in Training Commission (STRAC) did not support those requirements. Since no training area supported this lane training, he gave instructions to find suitable real estate on Fort Stewart. The G3 was directed to provide real estate and ammunition support to the maximum extent possible. Because the EQTs are similar to gunnery tables, the commander understands their importance and supports changing future STRAC allocations. He also supports constructing an area to conduct the EQTs.

The 10th Engineer Battalion was extremely successful with this new approach and significantly improved training development in preparation for the NTC. The organization of the tables yields a solid foundation for instructing and evaluating soldiers, squads, and platoons. Each soldier trained with the EQTs is fully capable of performing all sapper tasks to standard. The EQTs proved invaluable throughout our recent NTC rotation. They are a great tool for both Active and Reserve Component units.

Endnote:

¹ The battalion developed these qualification tables (shown on page 30) for their heavy engineer unit. During the second quarter of FY98, the U.S. Army Engineer School will publish a training circular with qualification tables covering all combat engineer units.



Second Lieutenant Corr is a platoon leader in B Company, 10th Engineer Battalion. He holds a bachelor's degree in civil engineering from Gonzaga University, Spokane, Washington.

Modernizing Sets, Kits, Outfits, and Tools

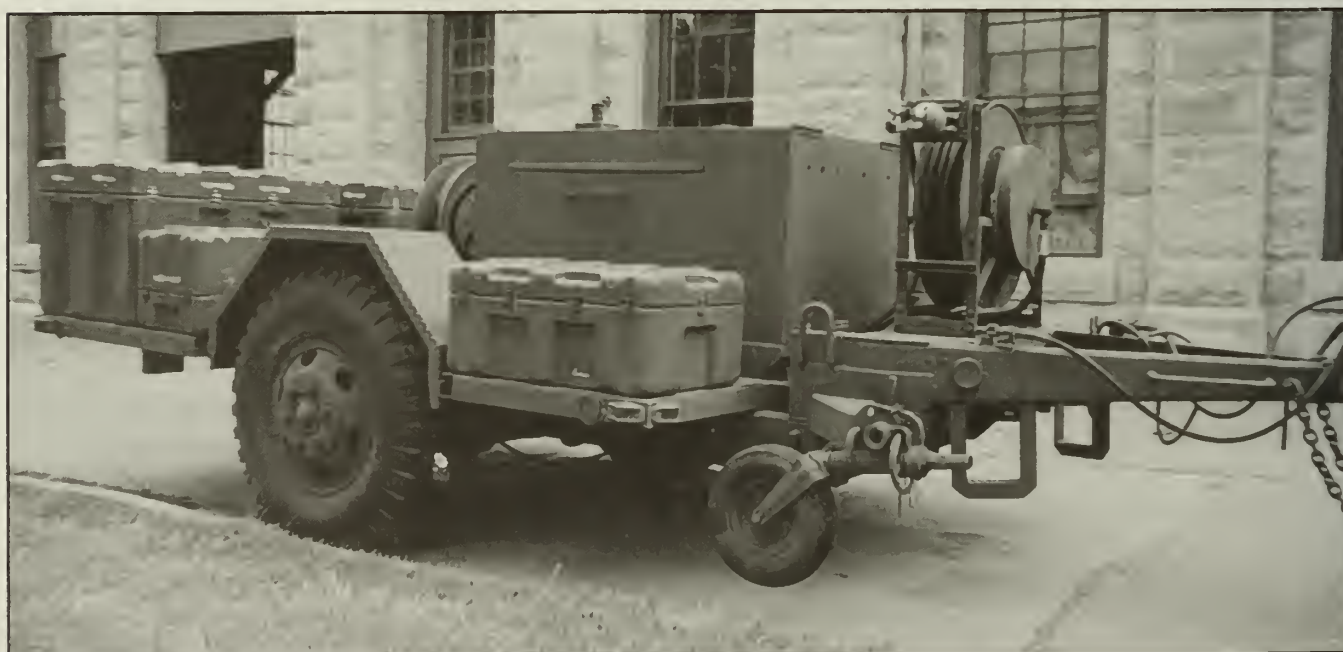
By Tom Knotts

The Army's old Pioneer Tool Set has a new look and a new name. Formerly known as the Set, Tool Outfit, Pioneer (Portable), line number (LIN) W58486, it has been updated and given a new designation—the Hydraulic, Electric, Tool Outfit (HETO). It is mounted on a 3 1/2-ton M353 trailer and pulled by a 5-ton truck.

HETO Improvements

The old system has been transformed from a marginally acceptable end item into an outstanding piece of equipment. The HETO boasts several improvements:

- It can be used with its onboard hydraulic or electric tools, which include a portable hydraulic motor generator, drills, saws (including a chain saw), lights, an impact wrench, sockets, and pumps. The HETO can simultaneously power one electric and one hydraulic tool or two hydraulic tools.
- The trailer is outfitted with six molded plastic boxes, two on each side of the trailer and two across the back. To minimize the cleaning associated with hydraulic fluid, all the hydraulic tools are packed in one box. They are mounted on a plate and secured with tie-downs, thus making it easier to remove and return them for stowage.
- Access to the power panel is more convenient, which simplifies maintenance on the power unit. The radiator opening is protected by a screen, and the engine cover on the opposite side of the controls is modified with vents. With these changes, the HETO can be operated without removing (and possibly losing) the panels. The power unit is rotated on the trailer and mounted with the radiator and fuel openings in front of the trailer. This configuration prevents spilled fuel or hydraulic fluid from falling on the trailer bed, which could cause the trailer deck to become slippery or fuel to drip off the trailer onto the ground and damage the environment. The position of the power unit



The M353 trailer carries the HETO and its power unit.



One of the HETO boxes contains a sump pump and hoses.

also eliminates possible environmental damage from leakage when draining the radiator or refueling the motor.

- The hydraulic motor generator is mounted on a plate and fastened in one of the plastic boxes, making it portable.
- Halogen lights on the HETO have roughly 10 times the life expectancy of the floodlights on the old system.

Fielding of the HETO will begin in the first quarter FY98.

Other Updates

In addition to the HETO project, the following sets, kits, outfits, and tools (SKOT) are being updated:

- *Shop Equipment, Woodworking, Base Maintenance, Trailer-Mounted, LIN T16988.* This set includes reciprocating saws and blades; chop, circular, table, and jig saws; routers and router bits; pneumatic nailers; and a compressor tool kit.
- *The Platoon Box (Carpenter's), LIN W34511.* It is equipped with electric rechargeable power tools such as saws, drills, an electric shear/nibbler kit, and an electric grinder.
- *The Squad Box (Carpenter's), LIN 34648.* This box includes manual tools such as a chisel set, a hacksaw with blades, hammers, a circle cutter, and a set of flat boring bits.
- *The Tool Outfit, Hydraulic Systems Test and Repair Unit (HSTRU), NSN 4940-01-036-5784, LIN T30377.* New state-of-the-art equipment will replace out-dated tools and fittings in this unit.

The trailer-mounted woodworking set has a General Service Administration National Stock Number (NSN) and can be purchased directly by units. The Platoon and Squad Sets will soon be given NSNs.

Supply catalogs containing changes to the SKOT above will be published on CD-ROM.

Most tools in the sets above are in the General Services Administration SCIT (Standardization and Control of Industrial-Quality Tools) Program, which lists 20,000 tools that are guaranteed for life. If one of them breaks, the contractor will replace it at no cost.

Future Updates

Sets to be updated soon are the Tool Kit, Mason, LIN W44923, and the Tool Set, Electric, LIN W60925. As additional SKOT revisions and improvements occur, information will be published in *Engineer* and on the *Combat Developments Newsgram* on the Internet at <http://155.9.32.3/DCD/CD%20NEWS/newsgram.htm>.

A kit containing the SCIT catalog and CD-ROM can be obtained by calling GSA Centralized Mailing List Service, Fort Worth, Texas, at (817) 334-5215.

The Engineer School's Directorate of Combat Developments welcomes ideas concerning how to change and improve these sets. The point of contact is Tom Knotts at: Commandant, U.S. Army Engineer School, ATTN: ATSE-CD-F-F, 320 Engineer Loop, Suite 166, Fort Leonard Wood, Missouri 65473-8929. The telephone number is DSN 676-7273 or commercial (573) 563-7273; the e-mail address is knotts@wood.army.mil.

Mr. Knotts is chief of the Force Integration Division, Directorate of Combat Developments, U.S. Army Engineer School.

The Light Task Force Engineer

By Captain Treavor J. Bellandi



Route clearance in restricted terrain is one of the most difficult and most common tasks a light engineer platoon will perform.

With the fast operating tempo of today's Army, new platoon leaders must "hit the ground running." For those fortunate enough to be in light, airborne, or air assault units, being a platoon leader is only part of the job. They must also fill the role of task force engineer for the infantry battalions they support, which is a full-time job in itself.

To help new platoon leaders perform their task force engineer missions as painlessly as possible, I have compiled lessons learned and suggestions garnered from the Joint Readiness Training Center (JRTC), the National Training Center (NTC), and other exercises I supported as a task force engineer.

The following information addresses how to prepare for an upcoming mission, staff planning, the engineer annex, and the tactical operations center (TOC). It is followed by three of the most common missions that engineers support. This article is not intended to replace doctrine or address all engineer missions. It is one soldier's perspective.

Mission Preparation

Proper preparation will save time later. For a field exercise, learn the scenario by reading everything distributed by the S2 and S3. Visit the infantry unit you support to get more information. Know your unit's capabilities. Use book times for obstacle preparation and route clearance only until you have worked with the platoon long enough to determine how much time these tasks actually take.



Soldiers in the TOC at JRTC prepare for an upcoming mission.

Rehearse staff planning skills by working with the infantry in both staff and field exercises. Staff rapport is more a function of your desire to help and learn than your technical knowledge. Obtain a copy of the infantry battalion's tactical standing operating procedures (SOP) and understand how they operate. To communicate effectively, understand your battalion, brigade, and division SOPs. Know the staff planning sequence (mission analysis, course of action development, etc.), your requirements to support the planning process at each stage, and what other staff officers are doing. FM 101-5, *Staff Operations*, and the Command and General Staff College manual, ST-101-5, *Command and Staff Decision Processes*, describe the sequence of tasks. Include the platoon sergeant and squad leaders in the planning process by bringing them to staff exercises with the infantry. Meet the people you support to build a better working relationship and a more cohesive team.

Once you know the basic scenario and your requirements, conduct battlefield preparation and prepare a shell for the engineer battlefield assessment (EBA) and engineer annex before the exercise begins. Prepare the written requirements as soon as possible to allow more time for troop-leading pro-

cedures once on the ground. After completing preparation and rehearsals, begin the actual planning process.

Planning and Coordinating

The staff sets the conditions of success for every mission through the PCISE (plan, coordinate, integrate, synchronize, execute) process. Execution is the culmination of all previous events, and following the PCISE process improves the likelihood of a successful operation.

Intelligence Preparation of the Battlefield (IPB). The S2 starts the planning process by developing the IPB. Task force engineers play a critical role in its development, because they are the staff experts on terrain analysis and enemy and friendly engineer assets and capabilities. Give the S2 initial information based on the EBA and fill in the gaps later. This allows him to begin constructing the IPB without being overwhelmed by extraneous information. The likely enemy course of action and the enemy engineer role in it are critical pieces of information the S2 needs. During wargaming, wear a red hat often to portray the enemy engineer and give the staff a better feel for their adversary.

Engineer Annex. As the task force engineer, you have a wealth of knowledge to give the staff, but you must use the proper vehicles to relay it. Fortunately, many assets (vehicles) are available. The brigade prepares an engineer annex, which should include an overlay and possibly a "trap map," which is a list of potential enemy ambush or mining sites within the sector. After you receive the brigade engineer annex, make a copy of the obstacle overlay so you can brief the infantry battalion commander. It may help to carry a personal map board with a small overlay.

Engineer Estimate. Develop your engineer estimate, then create and post execution and survivability matrices. Although you know what your squads are doing at any given time, a matrix helps the commander and the rest of the staff quickly see how engineers are supporting the fight.

Risk Assessment. Finally, conduct a risk assessment and be proactive in briefing the commander on risk management in areas where engineers are working. This will save time and possibly lives. Once you understand the plan, coordinate with other staff members to help solidify the engineer role in the scheme of maneuver.

Relay Information. The staff lives or dies with the passing of information. Since everyone immediately grabs his own annex from the brigade operations order, give the rest of the staff a summary of your annex. Share the trap map with the fire support officer (FSO) so he can target those locations. Information benefits no one if you keep it to yourself, so share it with others, including other platoon leaders, higher headquarters, and subordinates.

When passing information, remember that you have two chains of command to inform: the infantry task force and the brigade engineer. Send your target and obstacle lists to higher headquarters, using specific grid coordinates. Finally, don't wait for information to come to you. Acquire information from adjacent units on routes, obstacles, and displaced civilians who may affect traffic flow on main supply routes (MSRs) in your sector.

Integration. Although the commander and the rest of the staff want you to be part of the team, only you can ensure that engineers are integrated into the task force plan. When working with the staff, pace yourself. Marathon planning sessions are often necessary to produce the operations order in a timely manner. To remain effective, work to expand your staff planning span of attention. This requires sorting critical information from the less important, as well as learning to focus on the task at hand. Be assertive with the staff in getting your voice heard. Don't be intimidated because you are the lowest-ranking member. The staff is a team, and as the engineer, you are a critical member. While the commander makes the final decision, everyone must contribute so he can make that decision wisely.

Synchronization. This is an important part of the planning process. Take an active role in synchronizing engineer assets, especially scatterable mines. It is essential to understand scatterable mine assets and firing procedures, as well as the approval authority.

"Producing a concise, informative (engineer) annex is critical to mission success."

The Modular Pack Mine System (MOPMS) and the Volcano are important to both the offense and defense, and you are the subject matter expert. Help prepare both the friendly and enemy decision support templates. Calculate trigger points for scatterable mines and reserve targets (remember that triggers include decision time plus execution time plus transmission time). Keep in mind that trigger points must tie in to named and targeted areas of interest to be successful.

When the staff finishes the operations order, read it immediately and identify information that has not been coordinated, especially information not coordinated with the other slice elements. This will avoid conflicts in the different annexes and in the information put out to company commanders. Continue to coordinate and synchronize until execution is complete.

Updates. Your job in the TOC is not finished when the staff disseminates the order. Maintain contact for intelligence updates and fragmentary orders to which you should contribute. Also, think about follow-on missions, because at some point you will return to the TOC to begin the planning process again. PCISE is a dynamic process that requires continual updating and constant attention to make it work.

Engineer Annex

The engineer annex to the task force operations order is an important tool for informing infantry company commanders and subordinate leaders. Producing a concise, informative annex is critical to mission success.

First, decipher the annex you receive from higher headquarters. Carefully examine the mission statement, which contains both a task and a purpose. Learn the doctrinal terms for task and purpose to better understand the mission, and use doctrinal terms in your mission statement. After analyzing the mission, review the commander's intent, which has three parts: purpose, method, and end state. Read them to determine exactly what you must achieve for mission accomplishment. The commander's intent revolves around the decisive point and how he defines success. Communicate the intent to all of your soldiers, so they can carry on in your absence.

When writing an engineer annex, remember that the engineer mission is not necessarily the same as the infantry mission. For example, the infantry mission may be to conduct counterreconnaissance operations, while the engineer mission may be to construct an engagement area. The mission directly affects the tasks you designate to subordinate units. Depending on the mission statement, subordinate tasks may address either your squads or the infantry units to which your squads are attached. If the platoon is under task force control, the tasks refer to individual squads. Include any attachments to your unit, especially heavy equipment. Remember that the engineer annex is not the same as the platoon operations order, which your platoon will require when the task force order is complete.

The engineer annex is a vital part of any maneuver operations order. Although the S3 may limit the amount of space allocated to the annex, always include information the battalion and company commanders need to properly use engineers when they execute the plan.

TOC Procedures

Most new platoon leaders want to spend as little time in the TOC, and as much time with



Sappers move to the breach site at the NTC.

their troops, as possible. To accomplish this, hone your TOC operations to increase efficiency.

Keeping abreast of current events is key to working in the TOC. A lot can happen in a short time, so use DA Form 1594, *Duty Staff Journal*, to keep a log with a brief description of each event and the time it occurred. Also, track requests for information that you send to higher headquarters. As the battlefield changes and fatigue sets in, a written record serves as a reminder. Others in the TOC need to know what is happening, so include both friendly and enemy obstacles on the battle captain's map. Update your overlay and inform higher headquarters of changes regularly.

Bring enough supplies (acetate, markers, etc.) to the TOC to avoid having to borrow from others. Also, bring applicable mission training plans and other pertinent manuals. An old demo box makes a good storage container for manuals and an effective way to carry and protect written materials. You can also use it to establish your area in the TOC or to sit on. After being in the TOC once or twice, you will determine exactly what you need. Ask fellow platoon leaders for suggestions.

At times, the planning process and task force TOC will seem chaotic. Develop a plan for operating with the staff to avoid getting caught up in the confusion and failing to produce a successful plan.

Engineer Missions

The planning process is dynamic. While no two operations orders are the same, there are many similarities among the various missions that engineers perform. The following tips pertain to three of the most common engineer missions: offense, defense, and stability and support operations.

Offense. An offensive mission for the light task force engineer can be extremely difficult, because you may have to plan an attack without knowing what is on the objective. Resist the temptation to split squads piecemeal, one per company, just so everyone has engineer support. You only have one platoon, so you will have the greatest impact by massing the forces.

The most important aspect of an attack is the initial obstacle intelligence received from reconnaissance elements and the scouts. Send one or two of your best soldiers with them to provide engineer expertise before the breach. While the intelligence collection efforts are taking place, concentrate on other tasks, such as route reconnaissance and clearance on MSRs and infiltration lanes and countermobility on your flanks to prevent enemy counterreconnaissance efforts. As part of the initial EBA, consider the effects of illumination, weather, and sleep deprivation on both the attacker and the defender, and use these factors to your advantage. Also, consider the enemy's use of scatterable mines. Decide how you would breach a scatterable minefield if one is discov-

ered in your sector.

When planning an attack, consider the number of breaches and their separation distance. Doctrinally, a battalion task force requires a minimum of two breaches at least 100 meters apart. Unfortunately, the rest of the staff and the commander may not agree to this because of the amount of support required. Be prepared to support your position, but remember that the commander has the final say. Coordinate with the S3 and the FSO on the length and type of suppression and obscuration during the breach, and make sure you discuss the elements of SOSR (suppress, obscure, secure, and reduce) during the task force rehearsal. To increase command and control, consider positioning yourself at the breach site with the main effort.

Last, but not least, prepare for success. In other words, prepare for the transition to a hasty defense once an attack succeeds. Develop some realistic logistics requirements and time estimates to prepare the newly taken objective for the defense. Scatterable mines are one of the quickest and most reliable methods for repelling enemy counterattack forces. Short of that, using resupply convoys or helicopters to bring in Class IV and Class V supplies in preconfigured packages can be very effective, as long as you clear the route for the resupply convoy.

Defense. Every successful offense results in a defense, either hasty or deliberate.

Regardless of how long you expect to

defend the position, certain key concepts are relative to all defensive missions.

The most important elements of a defense are time and resource management. To speed the process, plan for a defense well in advance. It is better to build one obstacle to standard than to build several of them poorly. Ask the S3 to allocate infantry platoon hours to help with the countermobility effort.

After preparing a survivability matrix, ask the infantry battalion commander to sign it. This helps diffuse any problems your digging assets have with overzealous company commanders. Before digging, ensure that the supported unit sights in positions. Maintain strict accountability of the dig assets and carefully select who will be in charge of them. Based on experience, the infantry battalion command sergeant major is the best choice, but the maneuver commander must allow this.

Proper discussion of engagement area development warrants an entire article, but a few key concepts follow. Remember that your obstacle intent—block, turn, disrupt, or fix—must coincide with the maneuver commander's intent and that your obstacle plan must support his defense.

When planning tactical obstacles, be sure that counterattack lanes are open and have a plan for closing them. MOPMS works well for closing lanes, as long as the senior soldier on the site understands the firing procedures, trigger points, and safe distance. Determine casualty evacuation routes; some of these need to stay open during the entire engagement, and counterattack lanes may need to stay open as well. Coordinate with the infantry to provide security while emplacing obstacles, and try to walk the ground with the commander to ensure that the engagement area you create is fully used. At the same time, plan fires on all obstacles with the FSO.

Tactical obstacles are your responsibility, but also advise the company commanders on their protective obstacles and survivability positions. This is

a good job for squad or senior team leaders. It also reminds the infantry to properly report their protective obstacles.

Locate yourself either at the TOC or in the sector with the counterattack force, so you can verify that lanes are open before the commander launches the reserve into battle.

Stability and Support Operations. These missions include peace-enforcement operations and low-intensity conflicts. As you struggle to keep abreast of the status and location of your assets, minefields are the greatest threat.

The primary engineer tasks during stability and support operations are route reconnaissance, route clearance, and force protection. Obtain minefield rules of engagement for the employment and removal of mines, as well as when to clear minefields and when to simply mark them and find a bypass. Clearing is not the same as demining, so do not clear everything since it wastes resources and puts soldiers at needless risk.

During stability and support operations, you probably will have to deal with static security points (SSPs), better known as checkpoints. Develop a plan that includes relieving existing SSPs and building new ones. Be prepared for other construction projects as well, since not all stability and support operations are hostile in nature.

Battle tracking is key throughout this type of mission. Everyone must know minefield locations and how they are marked. Try to include engineers with all convoys traveling through your sector. This requires extensive S4 coordination, because the tendency is to send vehicles down MSRs before they are cleared. Coordinate with the S2 to update the IPB continuously. Identify and disseminate information on any new enemy mines located within the sector, including their type and changes in their employment (for example, whether they are buried, booby-trapped, or equipped with anti-handling devices).

To prepare troops for this type of mission, SOPs for minefield marking and clearing must be up-to-date. Rehearsals are important, too. If possible, practice combined arms clearance with the infantry, such as using thermal sights from their antitank weapons for mine detection.

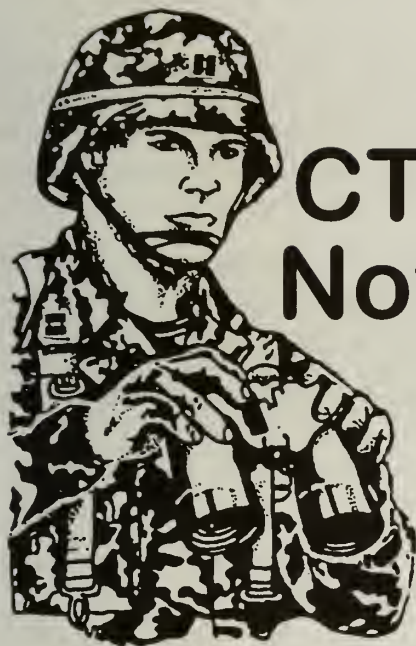
Communications during stability and support operations are crucial. Give your soldiers specific information through the use of good troop-leading procedures. Maintain communications with other platoons and coordinate with adjacent units when doing route clearance and convoy operations. The best place to maintain command, control, and communications is at the TOC.

Deployments to Haiti and Somalia, as well as exercises at JRTC, have shown that the task force engineer must manage assets all over the battlefield. While the enemy threat during stability and support operations may not be as great as in other missions, the danger is just as high.

Filling in the Blanks

The task force engineer's job is demanding, to say the least, and platoon leaders need help to accomplish everything the job requires. They must prepare and execute staff requirements effectively and efficiently to allow more time to lead their platoon. The information in this article will fill in some of the blanks that remain after the Engineer Officer Basic Course is completed and will give new lieutenants a base for working as a member of the combined-arms team. 

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CTC Notes



Joint Readiness Training Center (JRTC)

By Captain John C. DeJarnette

Integration of the engineer company into the light brigade combat service support (CSS) system remains a substantial challenge. There are three principle areas of concern:

- Unit Level Logistics System (ULLS) maintenance support.
- Management of Class IV/V supplies at the brigade level.
- Integration of the brigade rear engineer cell (BREC) into the forward support battalion (FSB) operations cell.

ULLS Maintenance Support

Light engineer companies lack organic ULLS ground computer systems and prescribed load list clerks. These assets are consolidated at the engineer battalion level and rarely deploy to the FSB with an engineer company. Because light companies have no organic ULLS support, automated equipment maintenance and dispatch must be provided by another unit. More importantly, without ULLS support, engineer company commanders lack access to the automated Open Document Control Register and the Nonmission Capable reports. Lack of access to these reports significantly complicates the company's ability to manage parts requests. Many units observed at the JRTC manually order parts using DA Form 2765-1. The manual system works, but visibility of engineer maintenance issues is lost at the brigade level because FSBs use automated products to prioritize and manage maintenance. The best solution to these shortcomings is to provide each engineer company with an organic ULLS ground computer. If that is not possible, we recommend the following procedure.

When an engineer company is attached to a maneuver brigade, the engineer company will "depart" its equipment from the engineer battalion ULLS and "arrive" it to the B Company FSB ULLS. This procedure provides automated maintenance management support to the engineer company and increases brigade-level awareness of engineer maintenance issues. Because the engineer company command post is located in the brigade support area, this arrangement allows the engineer company executive officer ready access to maintenance management information at both unit and direct support levels.

Management of Class IV/V Supplies

Rotational units lack viable standardized Class IV/V combat configured loads (CCLs). While most brigade tactical standing operating procedures (TACSOP) list CCLs and their contents, the FSB does not configure trucks, containerized delivery system packages, palletized load system packages, or low-velocity air-dropped packages in accordance with the brigade's standardized CCLs. As a result, unorganized packages are delivered to the forward logistics element or task force Class IV/V point. This means that task force leaders must organize the materials into packages that support the obstacle and survivability plans. The effect at the JRTC is loss of valuable preparation time while materials are sorted, reconfigured, and delivered. Typically, whoever arrives at the task force Class IV/V

point takes what they want regardless of the distribution plan. Engineers often are left to fend for themselves with little support from the task force S4 or executive officer. Frequently, critical Class V items such as MOPMS are not accounted for and end up in a unit other than the intended recipient. This undesirable effect is a result of poor planning and supervision of CCL construction and distribution. It is critical that CSS units package and distribute Class IV/V materials in accordance with the brigade TACSOP and operations order. Extensive leader involvement at the FSB and supervision by the brigade S4 and brigade engineer are required to correct this deficiency. We recommend that units comply with information in Appendix C, FM 90-7, *Combined Arms Obstacle Integration*.

Integration of the Brigade Rear Engineer Cell Into the FSB Operations Cell

The engineer company command post doctrinally serves as the BREC. However, it generally occupies the FSB perimeter as a separate tenant unit. This arrangement does not support effective integration of mobility and survivability operations in the rear area, as shown in the following paragraphs.

The BREC lacks organic mobile subscriber equipment. Therefore, it cannot receive or send fax traffic or be integrated into the brigade's local area network (LAN). The BREC typically is manned by the engineer company executive officer, first sergeant, supply sergeant, and one or two drivers. The workload associated with operating a separate company command post and the physical separation from the FSB reduce the effectiveness of the BREC.

The FSB has a significant requirement to track the status of supply routes within the brigade area of operations but is reluctant to call on the BREC for assistance, because that requires someone to walk from the FSB TOC to the engineer company command post. Additionally, the BREC can guide the preparation and distribution of Class IV/V CCLs but is not typically integrated into the CSS planning process at brigade level, because the BREC is not part of the FSB TOC.

We recommend integrating the BREC into the FSB TOC. This arrangement allows the BREC to become an important resource to assist the FSB with mobility and survivability functions that parallel those of the brigade engineer and the brigade main engineer cell. The engineer company gains visibility on Class IV/V issues and engineer company maintenance issues, gains access to mobile subscriber equipment

support, and improves manpower efficiency. Information flow is improved for both the FSB and the engineer company.

Please continue to send us questions and recommendations about mobility and survivability operations and techniques. Call (318) 531-0266/0282 or DSN 673-0266/0282. The e-mail address is: brooksje@polk-emh2.army.mil or dejarnjc@polk-emh2.army.mil.

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National Training Center (NTC)

A Disconnect in the Desert: Integrating Heavy and Light Engineers at the NTC

By Captain Chuck Samaris and Captain Otis Cagle

Commands and staffs must effectively integrate mechanized and light engineers to maximize their impact on the battlefield. Effective integration requires planning, coordination, and supervision. However, the engineer force seldom trains to effectively integrate these units except during heavy/light rotations at the NTC. Current trends indicate that problems develop when the mechanized engineer battalion commanders and staffs of a heavy brigade combat team (BCT) lack involvement in the planning, preparation, and execution of engineer support to a light infantry task force (TF).

Background

During typical rotations of heavy and light units at the NTC, the BCT deploys with three task forces—one armor, one mechanized infantry, and one light infantry. A mechanized engineer battalion consisting of a

headquarters and headquarters company and two sapper companies deploys with the BCT, and a light engineer platoon deploys with the light infantry TF. The BCT and light infantry TF usually have no habitual training relationship and have had little collective training prior to deployment. As a result, brigade engineers often overlook the engineer capabilities available within the light TF, and the light engineer platoon leader fails to consider that a higher engineer headquarters is available to provide guidance and support. These oversights inhibit effective integration of the mobility and survivability battlefield operating system (BOS) throughout the depth of the BCT battlespace.

Observations

The following considerations are based on observations that repeatedly lead to separate light and heavy engineer support to what should be a seamless fight.

- Consider the impact of the light task force's accelerated time line.
- Include the light engineer platoon's capabilities when conducting the engineer battlefield assessments (EBAs).
- Base the task organization on identified engineer tasks that have clear command and support relationships, decision points to shift units and assets, and link-up procedures. Do not task organize based solely on habitual relationships.
- Ensure that command and control requirements include reporting procedures and battle tracking of all engineer events in the brigade area of operations.
- Provide brigade engineer support to the preparation of the entire engineer force, including logistics and rehearsals.

Techniques and Procedures

The following techniques and procedures will help the light engineer platoon leader and brigade engineer collectively support heavy/light BCT operations.

The brigade engineer must consider support to the light TF early in the EBA and scheme of engineer operations (SOEO) development process. The light TF may cross the line of departure up to 12 hours before the main body of the BCT. Their early departure requires accelerated planning and execution time lines. Early in the planning process, the brigade engineer must plan and coordinate the critical resources and events that affect the light TF engineer.

For example, a BCT plans to infiltrate a light TF to establish a blocking position, and the brigade engineer resources the effort with Volcano and MOPMS minefields. For that to happen, the light engineer platoon leader must clearly understand the location of resources, link-up procedures, and the obstacle intent (if any) before the light TF military decision-making process is initiated so that he can integrate these assets into the scheme of maneuver.

The brigade engineer or his representative (S3, XO, assistant brigade engineer, or battle captain) must maintain routine contacts with the light engineer platoon leader during the planning and preparation phases of an operation to provide guidance and supervision. Contacts may be face-to-face or via mobile subscriber equipment or FM radio and are in addition to standard reports. Routine contacts should parallel those that occur between the mechanized engineer battalion and its organic companies. These contacts ensure that the total brigade engineer effort is properly focused and coordinated. They also provide the young light engineer platoon leader with senior engineer leadership in the absence of his company commander.

A liaison officer (LO) facilitates coordination between the brigade and light engineers. FM 101-5 provides a clear purpose for employing an LO, selection criteria, and general guidelines. The LO's mission is to coordinate and support engineer operations within the light TF, not to burden the TF TOC or engineer platoon leader. To maximize the LO's effectiveness, the brigade engineer must provide him with proper tools, including a vehicle with driver and a radio with dual-net capability. Use of an LO greatly improves engineer input to the TF military decision-making process, engineer tracking, engineer reporting, and future planning during continuous operations. In addition, use of the LO enables the light engineer platoon leader to focus on preparing his unit to execute the mission.

Note: For more information about liaison officers, see CALL Newsletter 95-7 (<http://call.army.mil/call/newsletters/95-7/tocsec5.html>).

When task organizing mechanized engineer assets to the light TF, the brigade engineer must clearly define command/support relationships and provide required engineer command and control (C2) nodes. For example, if a mechanized engineer platoon is task organized to a light infantry TF, the brigade engineer should immediately provide a C2 node to participate in

the TF military decision-making process and to coordinate the efforts of the light and mechanized platoons. The C2 node can be an S3 battle captain with a vehicle-mounted radio, who is assigned as the TF engineer. The C2 node will improve brigade engineer battle tracking of light TF operations. It also synchronizes the efforts of the two engineer platoons that are task organized to the light infantry TF and eases the transition of designated engineers to the new main effort after the light TF mission is completed.

The above observations and techniques revolve around command, control, communication, staff coordination, and leader supervision. We hope they

provide both mechanized engineer battalions and light engineer platoons with some important insights to help their units prepare for a successful heavy/light rotation. Remember the bottom line: Planning, coordination, and supervision are required to effectively integrate heavy and light engineer forces and maximize their impact on the battlefield. Good luck—and Train the Force!

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Engineers in the Future Army

By James L. Allen

With the exception of our senior leaders, few of us appreciate or understand two documents that shape our Army's future. They are *A National Security Strategy for A New Century* and the *National Military Strategy of the United States of America*. This article contains my views on how these documents impact the Engineer Regiment.

National Security Strategy

Dated May 1997 and signed by the President of the United States, this document is not currently available from the Government Printing Office. However, it is on the National Security Council's home page on the Internet at <http://www.whitehouse.gov/WH/EOP/NSC/Strategy>.

The *National Security Strategy* states that "The U.S. military plays an essential role in building coalitions and shaping the international environment in ways that protect and promote U.S. interests. Through means such as the forward stationing or deployment of forces, defense cooperation and secu-

rity assistance, and training and exercises with allies and friends, our armed forces help to promote regional stability, deter aggression and coercion, prevent and reduce conflicts and threats, and serve as role models for militaries in emerging democracies."

This document outlines the various threats military personnel may become involved with, which primarily include small-scale contingencies and major theater warfare. But military personnel also will help counter a host of other concerns, which are called "transnational threats"—terrorism, drug trafficking, international organized crime, and environmental and security concerns. In all, the *National Security Strategy* says that we "... in concert with regional allies, must remain able to deter credibly and defeat large-scale, cross-border aggression in two distant theaters in overlapping time frames."

National Military Strategy

This document is under revision, but the new version is expected to closely parallel the 1995 edi-

tion available through the Government Printing Office and on the Internet in various locations. The current *National Military Strategy* defines international dangers as—

- Regional instability
- Weapons of mass destruction
- Transnational dangers
- Dangers to democracy and reform

The document says that we will achieve our national military objectives through—

- Peacetime engagement
- Deterrence and conflict prevention
- Fight and win

This last area (fight and win) also focuses on engaging in two major regional conflicts simultaneously.

Engineer Locations

The Army has been reduced to 10 active divisions, with a total active duty force of 495,000 soldiers. Two or more divisional brigades

Research, Development, and Procurement Budget FY97-FY06	
<i>MDEP</i>	<i>Percent</i>
Engineer	00.6
Aviation	23.7
Combat Service Support	16.3
Command, Control, Communications, and Computers (C4)	15.0
Ammunition	13.7
Fire Support (includes Artillery)	10.0
Close Combat (includes Armor)	07.1
Air Defense Artillery	06.7
Intelligence and Electronic Warfare	04.9
Other	02.0
TOTAL	100.0

are located in Europe, Korea, and Hawaii; a contingency corps is stationed in the United States for rapid deployment; and reinforcing force divisional units are stationed throughout the United States. The active force in Europe is composed of four brigades, two "2-brigade slices" of the respective divisions—not two entire divisions. Engineers are assigned to each division. The third brigade of each division is CONUS-based.

About 76 percent of the engineers are in Army Reserve and National Guard units. That percentage is roughly parallel to the percentage of Reserve forces in transportation, quartermaster, and ordnance units. These reserve forces will deploy with their active duty brethren in the event of a real shooting war.

Facts of Life

Force Emphasis. The continued drawdown of the Army—and of engineer forces—has created some unique problems for future operations that are not intuitively obvious. We have shifted from a forward-deployed force to a power-projection force. Our forces once were planned for deployment into mature theaters

with road, port, rail, and air networks. Now they are more likely to deploy into austere environments, with Somalia being a prime example. Host forces may have limited engineer capabilities, and host-nation contractors may also be scarce. We may have to fight our way in, ruling out host-nation support altogether. Each of these events will impact the engineer force's ability to quickly perform its mission, which is to support the maneuver force.

Funding. Added to this new fact of life is another: Engineers are not being modernized at the same rate as some other branches—Armor, Infantry, Artillery, and Aviation. A look at the research, development, and procurement budget from FY97-FY06 shows that the seven separate Engineer and Mine Warfare MDEPs (Mine Warfare Management Decision Packages) are scheduled to receive less than 1 percent of the total (see table). That tiny amount includes development and fielding of both the Grizzly breacher and the Wolverine heavy assault bridge. The combined research, development, and procurement budgets for two systems—the Commanche helicopter (Aviation) and the Crusader cannon (Artillery)—dwarf all other

development efforts. The Armor Branch's armored gun system was successfully progressing through the development process but was killed to provide funding to other, higher priority systems. It is the first major system to suffer that fate but probably will not be the last.

For engineers, the stark reality of too many needs competing for too few resources means that to be successful on the "budget battlefield," we must first prove our worth to the Army's senior decision makers—who advanced primarily from the Infantry, Armor, and Artillery Branches—and to the maneuver force we support.

One impact of this resource-constrained environment is that the Army is currently pursuing a policy called "cascading." As new equipment is purchased, it goes first to those units most likely to use it, primarily Force Package 1 (FP1) units. Force packages are based on the "first to fight" principle, with those units most likely to go to war first being equipped with the most modern, most capable equipment. Equipment replaced in FP1 units is "cascaded" down to FP2, FP3, and FP4 units, each in turn. The Army sees this as a way of ensuring that the most modern equipment is in the hands of those



The Combat Engineer Vehicle (CEV) entered manufacture in 1966. It was retired in 1996, except for use in Korea and Bosnia. The CEV was never upgraded. The CEV will be replaced in engineer units with the Grizzly breacher, but not until 2004.



Photo courtesy General Dynamics Land Systems

When the CEV was fielded, the M60A1 was the Armor Branch state-of-the-art tank. It has been upgraded or replaced nine times since 1969, with current state-of-the-art being the M1A2. Two future upgrades are being developed.

"Simulations and simulators play an ever more important role in engineer training and battle planning."

most likely to use it (i.e., the contingency corps). It also helps ensure that our return on the original investment increases as lower priority units use older, less capable equipment.

But cascading has some unanticipated impacts. For example, in the field of topographic engineering, cascading means that as engineer units receive the latest digital terrain-portrayal equipment, they must remain capable of supporting lower-priority units as well. It does no good to have the most complete digital terrain data in the world if you cannot pass that information to a supported FP3 unit. That unit will need paper maps and terrain products long into the future, which means that topographic engineers must maintain multiple capabilities in both equipment and personnel.

This burden may be partly rectified by a political fact of life. Both the Army Reserve and the National Guard have some clout in Congress. Their backers have dedicated funds for certain equipment buys that cannot be afforded by the active forces. For example, in the sustainment engineering construction area, Reserve forces often have newer equipment than active duty units, which have a low priority for new construction equipment.

In some instances, active forces have taken advantage of this phenomenon by tacking their requirements onto Reserve buys, thus lowering the overall price of each system. As the budget for active forces becomes smaller, this unusual purchase arrangement probably will increase.

Goldwater-Nichols. Another fact of life Army planners must deal with is the Goldwater-Nichols DoD Reorganization Act of 1986. All Army table of organization and equipment (TO&E) units now are assigned to a joint command, as are their Air Force, Navy, and Marine counterparts. Goldwater-Nichols forced the military services to think "joint."

An outcome of "jointness" is the introduction of multiservice training at Fort Leonard Wood. Engineers and truck drivers from all four services receive part of their instruction here. In turn, we send Army engineers to Navy and Air Force facilities to learn other specialties.

The emphasis on jointness has carried over into materiel and doctrine development. Where possible, joint development efforts save time, duplication, and dollars. They also add to the interoperability of equipment among the four services and even with our allies. The future will include more joint training, perhaps at the National Training Center (NTC) or other locations.

Simulated Training. Simulations and simulators play an ever more important role in engineer training and battle planning. What we can simulate, we can "experience" to a near-real level of intensity without the cost associated with on-the-ground training operations. Both of the major new engineer systems under development, the Grizzly breacher and the Wolverine heavy assault bridge, are being developed with embedded simulator technology. Other systems will follow their lead.

Battle simulations are equally important. Historically, these high-tech computer games have not played engineer missions or have played them badly. New computer games bring engineer realities and dynamic environmental effects to the screen. What takes two hours to complete in the real world will take approximately the same amount of gaming time on the screen.

Practicing Engineer Skills. The need to practice all necessary engineer skills during live simulations is increasing, with those performed at the NTC being a prime example. One reason bridging the Sava River in Bosnia took so long is that river crossings are seldom practiced at the unit level, even at the NTC. In Bosnia, bridging was a seldom-tested skill for everyone involved. Only

the Americans would attempt to cross the Sava in the winter under flood conditions, but our relative inexperience increased the time and resources needed to accomplish the mission.

Conclusion

Warfighters of the maneuver force like to talk about being at the very end of the "pointy stick," and they are certainly out there in harm's way. But in reality the soldier who is truly at the end of a pointy stick is often an engineer, and the pointy stick is usually a mine probe. For the near future, that situation will not change, because cascading will make it necessary for engineers to retain their current mine-probing skills.

A significantly reduced budget will allow new equipment to be developed and fielded, but it will be in too few numbers to impact the entire force. Much of the force will remain equipped with older, less capable equipment, which will increase training and maintenance requirements. Although the quality of training will improve, tight funds may not allow units to receive all the training their leaders think is required. But when the next war comes and the next minefield has to be breached, or the next bunker defeated, or the next airfield repaired, engineers will be called to complete these missions—just as they are today.

Mr. Allen is chief of the Productivity and Management Division, Directorate of Combat Developments, U.S. Army Engineer School. He is retired from the U.S. Army Reserve with 24 years of active and reserve duty. Mr. Allen served with the 4th Infantry Division in Vietnam and with the 1st Infantry Division in Germany. He is a graduate of the U.S. Army Command and General Staff College, the National Defense University's National Security Management course, and the Army Management Staff College.



Make a Difference!

By Major Thomas H. Magness and Major Kenneth W. McDonald

Engineer senior lieutenants and junior captains who are deciding what to do during their "post command" years—after company command and before a field-grade assignment—have many exciting, challenging, professional development jobs available to them. But perhaps none can rival teaching at the U.S. Military Academy at West Point, New York. No other assignment offers greater educating, training, and mentoring opportunities as well as opportunities for developing technical expertise and experience in a relevant engineering field. Most importantly, nowhere else offers the opportunity to make a more profound impact on the future of our Army!

Successful Leadership

Assignments as senior captains and junior majors mark the transition point for most officers. Lieutenants and captains teach, train, and mentor privates and junior noncommissioned officers, while field grade leaders teach, train, and mentor junior officers.

The Command and General Staff College (CGSC) selection board recently

indicated that a successful field grade officer should demonstrate the ability to deal with abstract concepts; teach and coach; communicate effectively; plan, organize, and coordinate; lead and work with officer groups; check the effectiveness of systems, and understand systems and make them work. In addition, they should be ethical, concerned with soldiers and their families, and dedicated and selfless.

What better place to hone these abilities than at the single largest commissioning source of our Army's lieutenants? Practiced in an arena where subordinates (cadets) may be a future Chief of Engineers or other leader in the Corps, these leadership skills will make a difference for the Army and the nation.

Dealing With Abstract Concepts. Engineer officers on the West Point faculty teach courses in mathematics, physics, chemistry, engineering (civil, mechanical, systems, and environmental), and relevant liberal arts and applied-science topics. Instructors are given broad guidelines (course objectives) and a mission to structure a course to meet them. The course director, a title that most instructors carry sometime during

their tour, especially in departments with many elective courses, ultimately is responsible for structuring lessons to accomplish the required mission. Abstract concepts (objectives) must be structured in a logical, flowing manner and fit into a 40-lesson load. The specific approach is usually left to the course director. Engineer officers deal with abstract concepts when designing courses in wastewater treatment, hydraulic design, land-use planning, and other critical engineering and applied-science topics. Planning, organizing, and coordinating a semester of instruction is similar to organizing a major field exercise: Instructors must forecast for both the close battle (daily preparation) and the long term (resources, lectures, field trips, designs, etc.).

Teaching and Coaching. The classroom size of about 15 cadets allows time for each student to receive personal attention at West Point. Those needing additional help may meet with instructors after class or on weekends. Engineer officers also teach military skills in military-science courses (two-week intercession between semesters) and during summer training. Here, teaching and coaching in the profession of arms can

truly make a difference in how these cadets view their future employment. This is the fun part for both the cadets and the instructors!

Communicating Effectively. Communication skills, both oral and written, are challenged regularly. Instructors not only structure 55 minutes of classroom time but also present information to young men and women who may not understand the material and who possess different levels of motivation for learning. Instructors must make the material interesting and stimulating enough to meet both ends of the intellectual spectrum. Additional communication tasks include technical writing, professional presentations, and numerous targets of opportunity which are always available to the faculty at West Point, such as community speaking engagements and cadet clubs.

Leading Officer Groups. As course director, an instructor normally leads groups of up to 10 officers, although some groups may be larger. Structuring a course to meet academy expectations and determining course learning objectives (the mission) and lesson objectives (intermediate objectives) has military parallels and future leadership benefits. Conveying this information to fellow instructors, some of whom may be senior in rank, helps develop the ability to lead officer groups. Ultimate responsibility for the course lies with the course director and requires proficiency in time management, mission focus, and diplomacy. Balancing this requirement with teaching demands, additional instruction, cadet mentoring, and other extracurricular activities develops skills for future use in the BDU Army.

There are similar opportunities to work with fellow officers during the summer. Being a tactical or training officer during cadet field training at Camp Buckner can directly affect cadets' impression of the Corps of Engineers. Cadet sophomores train at the engineer committee's sapper training site on a variety of combat engineering missions. This is usually the first time that most of these cadets have seen engineer soldiers in action. Engineer officers serving as committee members, or as company or platoon trainers, have a great opportunity to "sell our branch." Terrain visualization (land navigation), dismounted sapper skills (infantry committee), and other combat arms skills are taught at other sites. Designing a site and its training objectives, forecast-

ing resource requirements, and leading groups of fellow officers in field training, mentoring, and coaching will pay big dividends for future missions. Working with and leading groups of cadets in combat-related tasks provides a great environment for developing those critical field-grade skills.

Moral and Ethical Development

At West Point, you may be asked—almost on a daily basis—about dedication, ethics, morals, and philosophical concerns. Cadets are taught and engage in these issues constantly as part of their developmental process. The cadet honor code is a cornerstone of their education and moral development. West Point faculty serve as company honor representatives and in the consideration-for-others program. Instructors are challenged to provide examples of moral and ethical scenarios from which cadets may learn. This provides opportunities for them to ask questions about the "real Army." Cadet questions are not limited to formal instruction periods. Often a class may begin with "hot" issues that lead to discussions on morality and ethics in the field. These opportunities are a large part of the overall character development process for each cadet.

Targets of Opportunity

Technical expertise developed in graduate studies, course preparation, and West Point research opportunities fills a great need for the Army and the Corps. Many theses completed by future West Point instructors have direct links to Army issues and often fulfill a research need for the military. These include studies and instruction in fields such as construction, construction management, environmental engineering, civil and mechanical engineering, land-use planning, water resource management, hazardous-waste management, dam stability, and coastal engineering. Many instructors schedule the Professional Engineer Examination during their assignment at West Point, since they are likely to be better prepared for it there than at any other time in their career. Passing this exam enhances an engineer's credibility in future Corps assignments.

Supportive Data

The authors conducted a survey of students from the Class of 2000 to identify the importance and role of rotating junior military faculty in regard to influencing cadets. The survey indicated that 47 percent of the 1,042 cadets surveyed thought the junior faculty had the most positive influence on them. The remaining 53 percent were split between four other categories. Of the cadets surveyed, 90 percent indicated that West Point provided the type of officers the cadets wanted to emulate. An amazing 86 percent of the cadets indicated that the military faculty were the greatest influence in their decision-making process for branch selection. These results indicate a need for the best officers in the Army to go to West Point, so they can make a difference in the lives of future Army officers.

The Bottom Line

The leadership of high-quality engineer officers at West Point has a tremendous impact across the academy's wide spectrum of activities. Mentoring future leaders in the role and importance of engineers on the battlefield occurs daily—both in and out of the classroom. We need our best, most motivated officers to convey a positive message to young cadets who are thinking about the Army and their future in it. The challenge is a great one. The rewards—both personally and professionally—are immeasurable. Make a difference!



Major Magness is attending the Command and General Staff College. He was previously an instructor of geography and environmental engineering at the USMA. MAJ Magness holds a master's degree in environmental engineering from the University of Texas and is a registered professional engineer in Virginia.

Major McDonald is an assistant professor of geography at the USMA. He holds master's degrees in geography and in city and regional planning from Western Kentucky University and is a registered professional engineer in Virginia and Wyoming.

Engineer Professional Bulletin

Readership Survey

PURPOSE: To better serve the needs of our readers across the Department of Defense, the *Engineer* staff request that you respond to the following questions. The information will be used to guide the content and format of future magazines. Due to budget reductions, we may reduce the number of paper copies published and rely more on electronic distribution, but meeting your needs remains our first priority. Your response will help determine our publication requirements.

To add your unit to *Engineer's* mail list, provide the complete military address at the end of the survey. *Engineer* is free of charge to military units.

Service: Army, Air Force, Navy, Marine Corps

Army Branch _____

Name _____

Unit _____

Commercial Phone No. _____

Location _____

Fax No. _____

Duty Title _____

E-mail Address _____

1. How many issues of *Engineer* have you seen in the past year?

a. 1

b. 2

c. 3

d. 4

e. None **(Go to Questions 8-10)**

2. How much of each issue do you read?

a. All or almost all

b. More than one-half

c. About one-fourth

d. Very little

For Questions 3, 4, and 5 use the following rating scale: (A=Excellent, B=Very Good, C=Good, D=Fair, E=Poor).

3. Rate the following departments for the value of information they provide.

a. Clear the Way A B C D E

b. Bridge the Gap A B C D E

c. Personal Viewpoint A B C D E

d. CTC Notes A B C D E

e. Past in Review A B C D E

f. Engineer Update A B C D E

g. Problem/Solution A B C D E

h. Book Review A B C D E

4. How do you rate the feature articles for their usefulness in your engineering duties and/or professional development? A B C D E

5. Overall, how do you rate *Engineer*? A B C D E

6. I would like to see more information on (select as many as appropriate):

- a. Highly technical engineering subjects
- b. Officer and NCO professional development
- c. Field operations
- d. Doctrine and equipment development
- e. Other: _____

7. After reading *Engineer*, I usually:

- a. Keep the issue for later reference
- b. Make copies of articles for reference and pass it on
- c. Pass it to someone else
- d. Throw it away

8. Do you have access to the Internet and the Engineer School's home page? (address is <http://www.wood.army.mil>)

YES _____

NO _____

9. Do you have capability to download information from *Engineer*?

YES _____

NO _____

WHY _____

10. Do you have capability to print information of adequate quality from Internet?

YES _____

NO _____

WHY _____

11. How frequently do you read *Engineer* on the Internet?

a. Quarterly, as Published _____ b. Search for Specific Topics _____ c. Browse _____

Additional Comments/Suggestions:

Please return completed surveys to: *Engineer Professional Bulletin*, Directorate of Training and Doctrine, 320 Engineer Loop, Suite 370, Fort Leonard Wood, Missouri 65473-8929.



ENGINEER UPDATE

Commercial numbers are (573) 563-xxxx and Defense System Network (DSN) numbers are 676-xxxx unless otherwise noted.

Monthly DOT Notes Newsletter. Engineer leaders now can subscribe to *DOT Notes*, a monthly newsletter from the Director of Training. *DOT Notes* will improve communication between the Engineer School and field personnel by—

- Informing leaders of issues concerning doctrine, training, leadership, and personnel proponentcy.
- Informing leaders of changes to the Fort Leonard Wood home page.
- Soliciting comments and feedback on issues and publications.

The first issue of *DOT Notes* was sent via e-mail to about 60 battalion and brigade commanders in June. Request your assistance to expand the subscriber list to all engineer leaders. To subscribe to this valuable new service, e-mail the following information (in the sequence shown) to Jim Evans at evansj@wood.army.mil.

- Location (state or country)
- Component
- Unit
- Position in unit
- Rank
- Name

POC is Jim Evans, -6197.

Postal Address Changes. New postal regulations require that all bulk mail be addressed with 9-digit ZIP codes. To update our mail list, we request everyone check the address on the envelope containing this magazine and provide us a corrected military mailing address. All military unit addresses (including APO and FPO addresses) must include a U.S. Post Office-approved street address and full 9-digit ZIP code (ZIP plus 4). To update your address, send us both the OLD and NEW addresses (see form on page 42). POC is Catherine Eubanks, -4104.

Field Manuals (FMs) Distributed. The following publications are scheduled for distribution:

- FM 90-13, *River-Crossing Operations*, will be distributed 2d quarter FY98. This manual describes how divisions and brigades conduct river crossings. It shows the relationship to corps operations, where appropriate, and includes details for lower echelons to support the brigades.

- Change 1 to FM 5-71-2, *Armored Task-Force Engineer Combat Operations* and Change 1 to FM 5-71-3, *Brigade Engineer Combat Operations (Armored)*, are scheduled for distribution in November. These changes update the format for the engineer annex to the maneuver operations order (OPORD) and the engineer unit OPORD to comply with the revised FM 101-5. The most significant change is in the engineer unit OPORD. The scheme of engineer operations (SOEO) has been moved from paragraph 3 to paragraph 1. The SOEO is replaced in paragraph 3 by a concept of operations paragraph. This change allows engineer commanders to fully explain how their unit will accomplish its mission, especially in offensive operations in which the engineer commander is the breach force commander.

These manuals are on the Engineer School's Publications Page on the World Wide Web: <http://www.wood.army.mil/DDDD/PUBS/pubs.htm>. POC is Lucius Warrick, -4015.

Directorate of Training (DOT)

**Department of Training and
Doctrine Development (DOTD)**

Staffing of Draft Publications. The following publications are staffed for review:

- FM 20-3. The draft revision of FM 20-3, *Camouflage, Concealment, and Deception*, will be staffed to the field for comment using a combination of disk copies and the Internet. The draft is currently posted on the Engineer School's Publications Page (address previously given) with a suspense date of 28 February 98. POC is CPT Joe Birchmeier, -4015.

- FM 5-434. The draft revision of FM 5-434, *Earthmoving Operations*, is scheduled for distribution and posting to the Engineer School's Publications Page in December. POC is Lucius Warrick, -4015.

Engineer Personnel Proponency Office (EPPO)

Itschner Award and Sturgis Medal. It's time for engineer companies to focus on the past year's achievements and prepare submissions for the 1997 Itschner Award and Sturgis Medal. These submissions reflect the culmination of a year of hard work for the company and the selected NCO. Submissions are due at Fort Leonard Wood by 10 February 98. The best submissions from an engineer company and an engineer NCO from each major Army command will be selected in April. Each unit should consider its own time line and plan from that point. Information on the composition of both the Itschner and Sturgis nominating books are in Fort Leonard Wood (FLW) PAM 672-1, dated 11 March 96. A winning Itschner book is described in an article published in the August 1995 issue of *Engineer* (page 49.) POC is SGM John Murphy, -4087.

New Grizzly Award. The Grizzly, a new award sponsored by the Army Engineer Association, recognizes outstanding contributions to military engineering, as demonstrated by technical and leadership expertise. The Grizzly Award is offered annually to an engineer platoon leader in each Army component (Active, Reserve, and National Guard). Selection criteria and nominating procedures for the Grizzly Award are the same as those for the Sturgis Medal, as described in FLW PAM 672-1. The deadline for submitting nominations to the Engineer School is 10 February 98. POC is SGM John Murphy, -4087.

Department of Tactics, Leadership, and Engineering (DTLE)



Cover of CD-ROM

Terrain Visualization Instructional CD-ROM. The first version of an instructional CD-ROM created to help professional engineers become more effective terrain experts is being distributed to engineer units in November. Titled *Terrain Visualization*, the CD-ROM provides tutorials to guide soldiers through the important terrain issues, map information, and digital requirements of Army XXI. Included are a gallery of terrain visualization products, points of contact at the Engineer School, and a copy of the latest Terrabase II program with several sets of elevation data and imagery. The Terrabase II software program is designed to give staff officers and leaders at brigade level and below a simple yet powerful terrain visualization tool. Instructions for operating the Terrain Visualization CD-ROM and Terrabase II are provided. If your unit does not receive the CD ROM, call CPT Wendell Stevens or Mark Adams at -4134/4123.



Lead the Way



*By Command Sergeant Major Robert M. Dils
U.S. Army Engineer School*

Greetings from your Engineer Center! Much has happened since CSM Julius Nutter and I transitioned this summer, and many of the issues that have surfaced will impact non-commissioned officers (NCOs) throughout our great regiment. CSM Nutter is a consummate professional command sergeant major, who always has the right answer to every problem and situation. The Engineer Regiment will miss him, and we wish him well in his new career. I will do my best to follow his great lead.

For the past few months, there have been sensational stories in the news media about sexual harassment and the courts-martial at several posts, including Fort Leonard Wood. A very small number of the nearly 500,000 soldiers on active duty chose to violate a sacred trust, and now those we serve and protect are having doubts about our Army. All of our victories, accomplishments, and sacrifices are overshadowed and somehow tainted. Good soldiers working hard in Macedonia, Namibia, and Laos pass unnoticed while headlines focus on the criminal misconduct of a few. This sickens me. Now, I want to devote the rest of this article to what we have done and plan to do to improve our great Army and the Engineer Regiment.

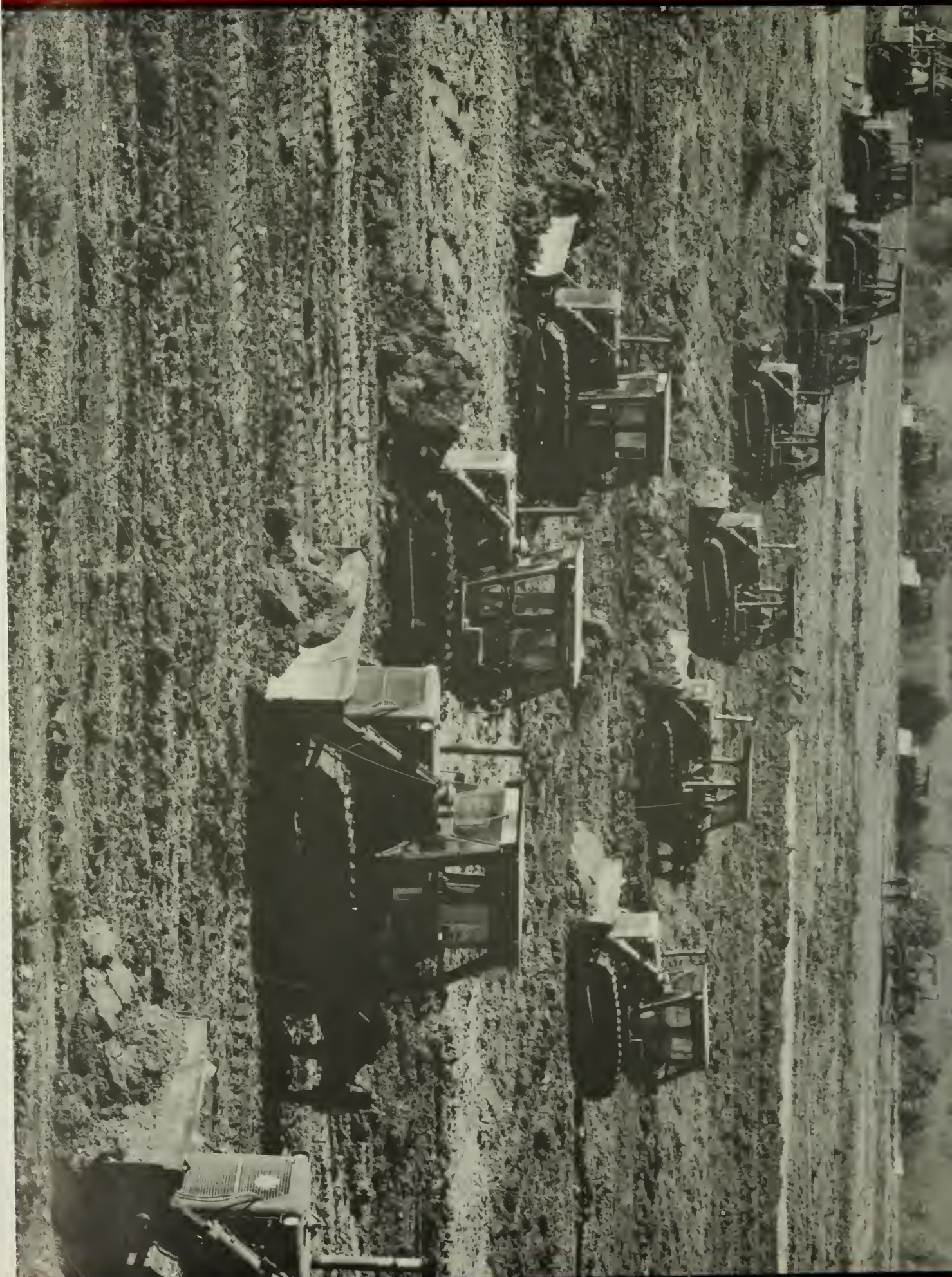
The Army has defined what constitutes sexual harassment. A simple test for appropriate behavior is to treat every soldier as if you are in public in front of your mother and father. Would your parents be proud of you? The best policy is to make certain they always are. Treat every soldier with the respect the uniform demands, and all forms of harassment and discrimination will vanish. Those guilty of misconduct have been punished, and now we must heal ourselves and get on with the mission.

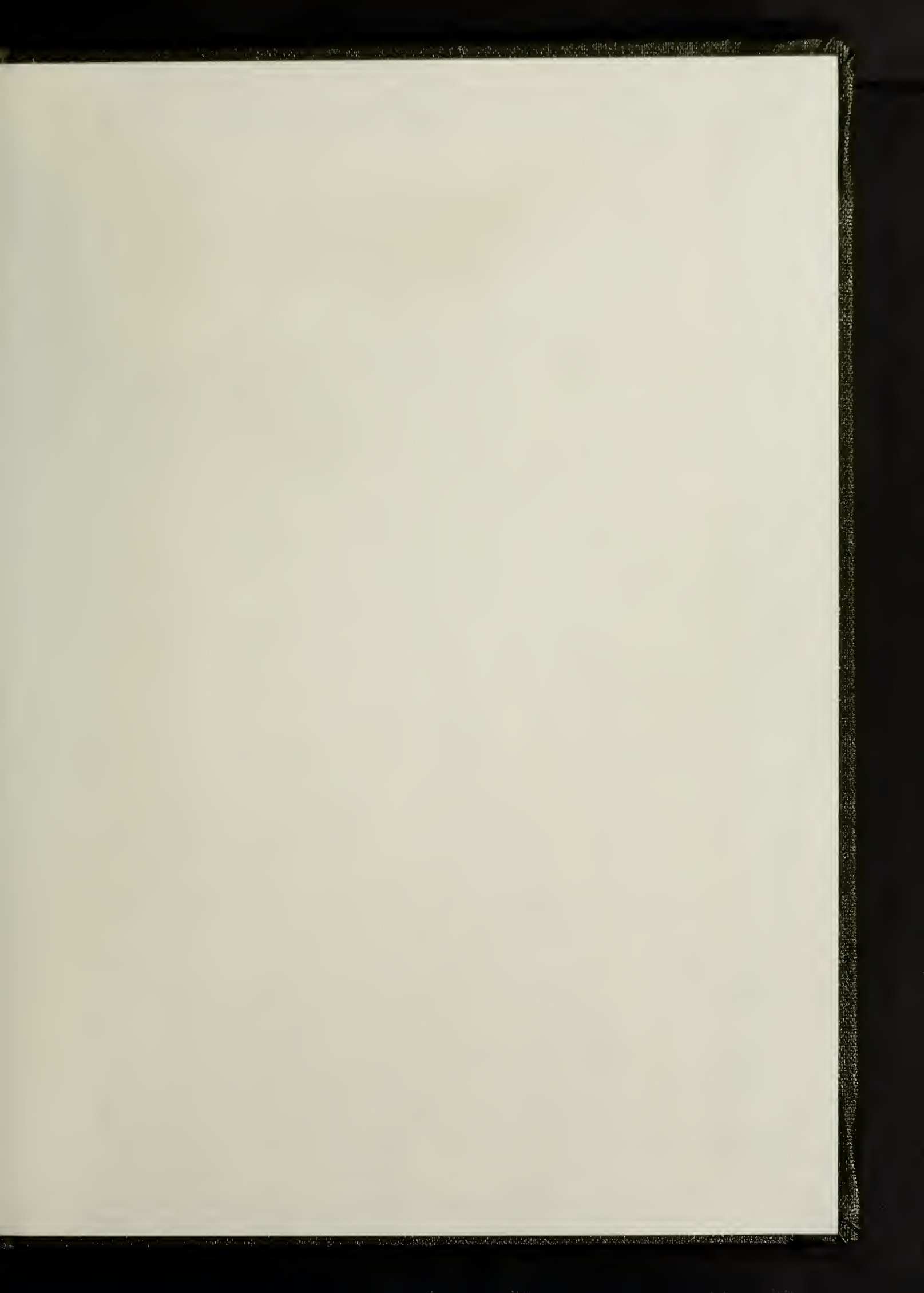
Since arriving at Fort Leonard Wood, I have visited our NCO Academy, the Drill Sergeant School, and many of the training units on post. My intent was to see firsthand if we have the proper foundations to train America's sons and daughters. I was very favorably impressed by what I found. Our nation's most precious resource could not be in better hands. Our institutions are sound and vibrant, and they are producing the finest NCOs to train America's finest soldiers. Our foundations are rock steady.

So what can we do to heal the wound? Nearly three months ago our new commanding general, MG Flowers, jumped on this problem with both feet, and I was right with him. First, he spoke with every drill sergeant on post to allay fears, dispel rumors, and express his personal confidence and trust in all of them. Next, he tasked each drill sergeant to write him a letter stating how to improve our post. The ideas and concerns expressed in more than 400 letters were distilled into 30 issues. Process Action Teams (PATs), made up of NCOs, have considered these issues, developed solutions, and recommended changes. As I write this article, the changes are being implemented to hone and fine-tune our post to better serve our Army. In future articles I will address some of the specific changes we are making and highlight our successes.

I will close on an 'up-note and express a friendly challenge to our fellow combat-arms NCOs. It is a pleasure to recognize the unique accomplishment of an outstanding engineer, CSM Harold Montgomery, who was recently chosen to be command sergeant major for the 1st ID. Hooah! He is the first engineer NCO I can recall to receive such an honor and vote of confidence. So, to all other combat-arms branches, be warned. Engineers are leading the way.

Your Engineer Center Army 10-Miler Masters' Team was first again—three years in a row. Hooah!





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